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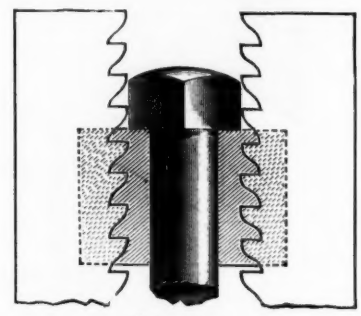
New Press and Milling Machine.

We illustrate with this a machine recently placed upon the market by Messrs. Nicholson & Waterman, of Providence, R. I. As shown, it is arranged for milling or finishing the heads of bolts and nuts, and in this feature alone the gain over other methods is claimed to be very great, both in points of accuracy and efficiency as well as cost of labor.

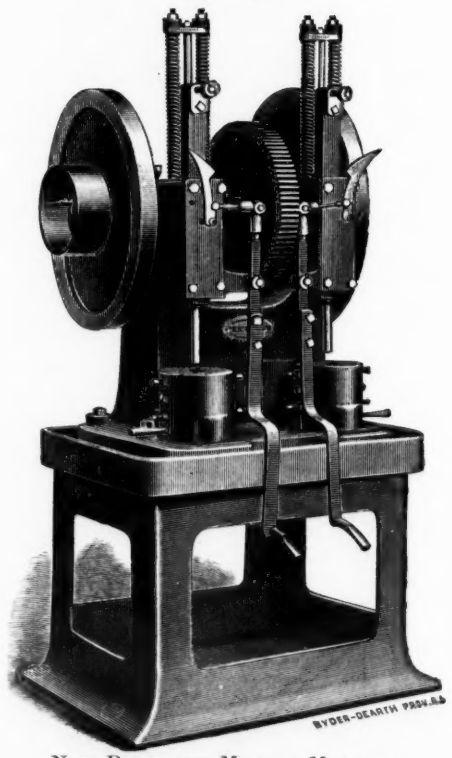
The press proper consists of a heavy frame or standard having immediately below the working level a gutter or trough to catch the oil or other lubricant as it leaves the work. The power is received by a back shaft having two balance wheels, from which it is transmitted to a second shaft by heavy gearing. Upon this shaft are two pinion gears, which are loose until thrown into action by sliding clutches. These pinions drive or force the plungers (solid bars of iron having rack teeth cut the length of one side) down upon the work until a system of lever attachments unclutches automatically the feed pinon, when the plunger, being freed from this force, returns to its highest point under the action of two powerful springs. By this arrangement the loss of time in operation is reduced to the lowest possible limit.

While intended for general press work the arrangement shown is that of the new milling attachment, the principle of which will be understood from an examination of the sectional cut. Two straight mill cutters or broaches are placed parallel to each other, but open more at the top than at the bottom. By driving the bolt or nut down through these it will be seen that the two opposite sides are dressed simultaneously and parallel. If now the operation be repeated twice, the result will be for a hexagonal nut three cross diameters exactly the same. The diameters being equal it only remains to secure truth with the stem of the bolt or hole of nut, which is obtained by means of the guide block shown between the cutters, the top of which is channeled out the exact width of the head of bolt and central with stem, and exactly 90° or 60° with face of cutters as square or hexagonal work is being done.

This machine is easily operated; the solid block holding the cutters and guide being pivoted to one side of the center, and in front is swiveled from under the plunger to facilitate the entering of the work, which, when returned to line of plunger, is forced though and falls into a pan from which the operator takes it for further dressing. Although powerful and rapid in its action, all the heavy work is performed by the machine, and it is claimed that an ordinary lad can dress with it from 600 to 1,000 hexagonal nuts per day.



SECTION.



NEW PRESS AND MILLING MACHINE.

Mr. Doremus, a clerk in the Treasury Department at Washington, is said to have invented a new lock which it is thought will be used in post offices. It is said that while any number of keys may be made to lock and unlock it, it can only be unlocked from the outside by the particular key used in locking it. It is not made clear why this is so, but it is said if the holder loses his key it can be unlocked from the inside, and then locked and unlocked from the outside by any of the keys.

English Boiler Inspection.

BY W. H. BOOTH.

In the year 1854 the frequency of boiler explosions in England led William Fairbairn, of Manchester, to associate himself with several other leading men—engineers and manufacturers—in forming a mutual association which still exists under the title of the Manchester Steam Users' Association, for the prevention of steam boiler explosions. The progress of this association has been slow, but sure. Its working has been most satisfactory, and it has enjoyed a remarkable immunity from accident to any boiler enrolled on its lists. At the present time the number of boilers under the control of this, the parent society, is something over 4,000 only, whilst in the British Isles it is estimated that there are somewhere about 100,000 boilers on land. The association is not a commercial undertaking, and does not, in the strict sense of the word, insure the boilers under its charge; but some few years ago, as an evidence of the soundness of its inspections, it commenced the system of guaranteeing every boiler which conformed to its requirements to the extent of not more than £500 ($2,400). Every boiler, no matter of what size, which is satisfactory, is guaranteed; the fund at the back of the guarantee consisting partially of accumulated surplus and partly of a sum of £10,000 ($48,000) guaranteed by ten members of the board of directory to the extent of £1,000 ($4,800) each. The association withholds its guaranty from any boiler which is defective in strength, setting, mountings, or in the mode of working, and so it comes about that many boilers are inspected by the association without being guaranteed, the owners perhaps desiring the safeguard of inspection and perhaps undesirous of incurring the expense of the suggested alterations or holding contrary opinions as to their need.

Many other societies for the inspection of steam boilers have since been started, and there are probably now existent about twelve, of which five have their headquarters in Manchester, the others being located in Bradford, Newcastle, London, Swansea, Glasgow, and in the Midlands. All the later companies work upon a different basis from the parent society, and are simply insurance companies, and pay, or aim at paying, dividends to stockholders. The cutting of rates which has been thus brought about has had the effect of reducing to a considerable extent the efficiency and frequency of the inspections, and the original rule of the parent association, that a boiler should be examined internally and in the flues at least once a year, has by no means been generally adhered to, and explosions of insured boilers are by no means rare. Of the total of 100,000 stationary boilers above named there are probably about 50,000 enrolled on the books of some one of the various companies above indicated. Half the boilers in Great Britain and Ireland are probably without inspection, and about 50 boilers annually explode. Nothing has more clearly been shown by the last 30 years of inspection than that boilers explode from no mysterious causes, but for simple and well defined reasons; the chief being weakness, either structural or from corrosion, the most being malconstruction and the least being bad attendance. Thus it is the owners rather than the firemen who are to blame for explosions, for inspection would disclose the weakness or malconstruction. In a future article we shall describe the methods of inspection adopted, and indicate the chief defects met with in the types of boilers commonly used in England.

Recording Pressure Gauges.

We make the following extracts from a paper presented by Chas. A. Hague at the seventh annual meeting of the American Water Works Association, at Minneapolis, Minn.:

If safety valves are supposed to be set at any certain pressure, you can never tell whether they have been tampered with, or whether they failed to blow off when that pressure was exceeded, or how many times a day or night your boilers have been exposed to an excess. There are more things happen to boilers at night, when they are supposed to be under low pressure, or when the pressure is supposed to gradually fall to zero, than people are aware of. If a careless fireman keeps up his fires too strong towards stopping time, when the machinery is brought to rest the heated bricks in the boiler setting walls will run up the steam pressure sometimes far above the regular working point; and if a blowing safety valve would betray such a state of things, the moving out of the weight will prevent the blowing, even if it does finally ruin the boiler. A good recording gauge will completely expose such practice, and not only that, it will sound an alarm at the precise moment the limit of pressure is reached. Doing a thing right may be acquired as a habit, and actually less labor is involved than in doing it wrong. * * * * The engine is responsible only for the steam it receives, but the fireman is responsible for the amount of coal required in producing the steam; it has been demonstrated to be possible to get away with a third more coal than is necessary to produce the power required, simply by departing from the practice of correct firing. The fuel should be burned down to a proper point, so that the furnace will not gradually fill up with unconsumed coal; the first thing a green fireman does is to gradually get his furnaces filled up with coal, working oftener and harder than necessary. If a number, say four or six doors, are to be fired into, each should be fired separately, with an interval between, regulating the damper to correspond, and keeping the water at the same level in the boilers. Firing is much easier work when properly understood and manipulated. Some men will fill a furnace full of coal so as to have more time to walk around; up goes the steam pressure, because more heat is generated than is wanted, then the feed water is turned on and the water level is run up so as to keep the steam pressure down, the safety valves blow, or they may not blow. The dampers are closed, the fires smoulder, large quantities of carbonic-oxide gas go up the chimney, which is simply an escape of unconsumed fuel not wanted at the moment; after a while the fires burn lower and down goes the steam pressure, helped down by a fresh furnace full of coal, the feed water is turned off and the water level run down to help the steam up. Imagine the final effects upon boilers used in such a manner, and also imagine how such an outrage can be perfectly exposed and prevented by a constant, unerring record of what takes place every minute of the day and night. * * * * The writer has in mind a water works system on the reservoir plan, under a pressure of about 120 pounds, where numerous house boilers commenced to give out, that up to a certain day had seemed strong enough. After considerable damage had been done during two or three weeks, it was discovered that the trouble was caused by water ram, the result of a connection having been made for water for locomotives, and the valve closed very quickly when the engine tank was full. The application of an ordinary water press-

ure gauge graduated up to 300 pounds, developed the fact that the static head produced a pressure of 120 pounds at the point of draft; when the engine tank was being filled through a wide open 6-inch valve, the pressure fell to 85 pounds, and when the valve was quickly closed, as it always was, the pressure ran up to considerably above the 300 limit of the gauge, and after five or six vibrations from just below 100 up to more than 300, the pressure gradually settled down to 120 again. A smaller pipe, an air chamber and a safety valve cured the trouble, after it was located. A good recording gauge would have rung an alarm and disclosed the excessive pressure the first time it occurred, saving many times its cost. Innumerable instances might be cited, but they would only exhibit the surprisingly large number of unforeseen and unsuspected occurrences, possible in a system of pipes laid in the streets of a city for water works purposes. The ordinary gauge drops away and then comes back to the normal pressure, or raises and returns again to the regular point, but who sees it? It goes through the same fluctuations as the recording gauge, but who can read it, or realize what it means, until it is graphically delineated upon a chart divided off to suit the hours of the day, even exhibiting when and for how long each sprinkling cart was drawing water; the precise moment that a pipe burst, and how long before the fractured pipe was thus off from the system; any irregularity in the operation of the machinery, etc., etc.

Practical Drawing.

By J. G. A. Meyer.

THIRTY-THIRD PAPER.

331. We have seen that the full lines, representing the upper edges of the truncated prism in Figs. 233 and 234, are shorter than the edges themselves. It has been explained how we can find the true lengths which are represented by the dotted lines in Fig. 234. It must also be noticed that the magnitude or size of the angles formed by the full lines in Fig. 234 is not the true magnitude or size of the angles; but the true or correct size of the angles is that which is formed by the dotted lines. Here, then, two simple problems suggest themselves: 1st. Suppose a single line only is given by its projection, how can we find its true length? 2d. Suppose two lines intersecting each other are given by their projections, how can we find the correct size of the angle formed by these lines? These problems we shall now consider; and we will also explain how the principles connected with their solution can be applied to every-day practice.

Problem 40.

332. To Find the Length of a Straight Line in Space, given by its Two Projections.

Fig. 235. Let $c\ d$ be the vertical projection, and $c_2\ d_2$ the horizontal projection of a given line; and let $A\ B$ be the ground line. It is required to find the true length of the line which is represented by these two projections. We may state this problem in this manner: If $c\ d$ is one view of a given line, and $c_2\ d_2$ a plan of the same line, what will be the correct length of the line which is represented by these two views?

For the sake of brevity, instead of saying the horizontal projection $c_2\ d_2$ of the given line in space, we simply say the line $c_2\ d_2$; and instead of saying the vertical projection $c\ d$ of the given line, we say the line $c\ d$; and when we have occasion to refer to the given line in space, we say the line $(c\ d, c_2\ d_2)$. A similar method of designating the points will also be used. Thus, instead of saying the projection c or c_2 of the point, we simply say the point c or c_2; and when we wish to refer to the point in space which is represented by these projections we say the point (c, c_2). Hereafter we shall use a similar method of designating the projections of lines and points and the given lines and points in space.

Since the line $c_2\ d_2$, Fig. 235, is shorter than the line $c\ d$, we at once conclude that the line $c_2\ d_2$ does not represent the correct length of the given line $(c\ d, c_2\ d_2)$. Now, the question arises: Does the line $c\ d$ represent the true length of the given line? To this we answer, No; because none of its projections $c\ d$, nor $c_2\ d_2$ are parallel to the ground line; and therefore (see Arts. 243, 244) the correct length of the given line in space cannot be obtained by measuring one or the other of its projections. Consequently, to find the correct length, we employ one of the following methods:

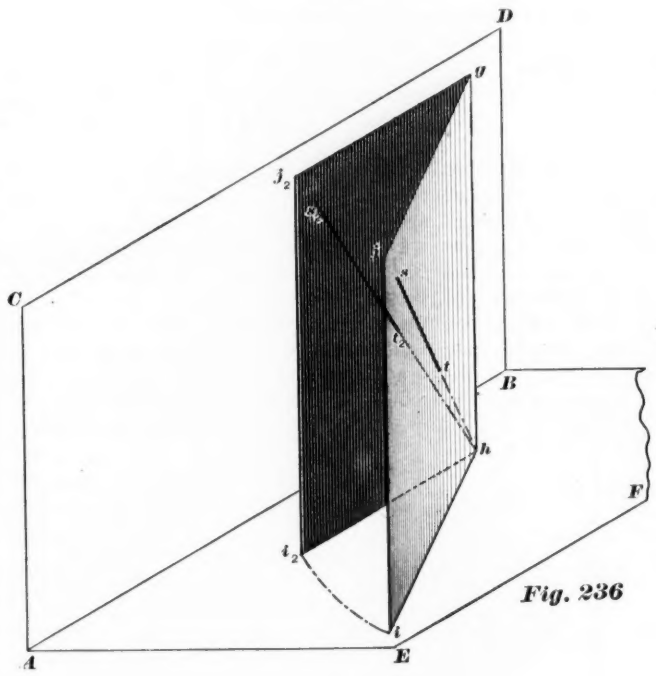


Fig. 236.

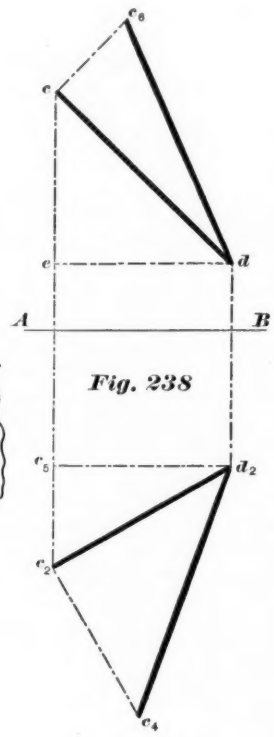


Fig. 238.

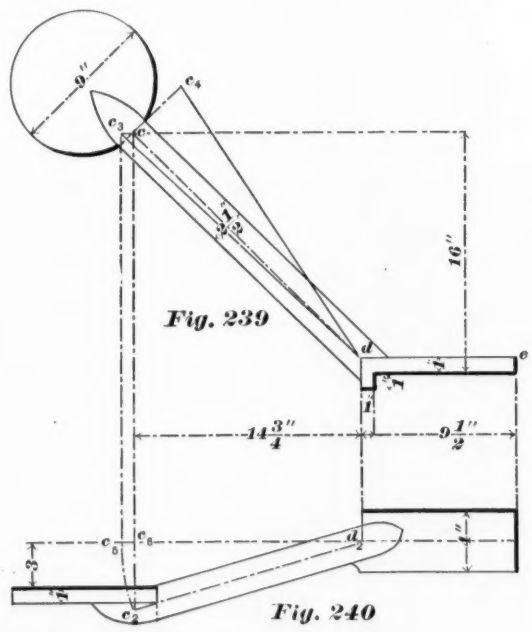


Fig. 239.

Fig. 240.

First Method.—See Fig. 235. Prolong the line $c\ d$ so as to cut the ground line $A\ B$ in the point f, through f draw a straight line $f\ f_2$ perpendicular to $A\ B$, and prolong the line $c_2\ d_2$ so as to cut the line $f\ f_2$ in the point f_2; through the point f_2 draw a line $c_5\ f_2$ parallel to $A\ B$; again, through the point c and also through the point d (that is, the ends of the line $c\ d$), draw the lines $c\ c_3$ and $d\ d_3$ parallel to the ground line $A\ B$. From the point f_2 as a center, and with a radius equal to $f_1\ c_2$, describe an arc $c_2\ c_5$ cutting the line $f_2\ c_5$ in the point c_5. Through the point c_5 draw a line $c_5\ c_3$ perpendicular to $A\ B$, and cutting the line $c\ c_3$ in the point c_3; join the points c_3 and f by a straight line, cutting the line $d\ d_3$ in the point d_3; then will the line from the point c_3 to d_3 represent the correct length of the given line $(c\ d, c_2\ d_2)$ in space.

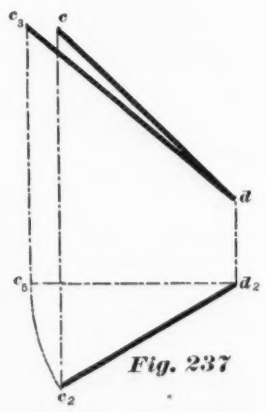


Fig. 237.

333. The principles upon which this construction is based are shown in Fig. 236. In this figure let $s\ t$ be the given line in space, and not parallel to either plane of projection $A\ B\ C\ D$ or $A\ B\ E\ F$. Let $g\ h\ i\ j$ represent a plane standing perpendicular to the horizontal plane of projection $A\ B\ E\ F$, and also passing through the given line $s\ t$; or in other words, let $g\ h\ i\ j$ represent the projecting plane (Art. 236, 243) which projects the line $s\ t$ on the horizontal plane $A\ B\ E\ F$, the line $g\ h$ in the projecting plane standing perpendicular to the horizontal plane of projection $A\ B\ E\ F$. Now assume this plane $g\ h\ i\ j$ as being turned around the line $g\ h$ (like a door) carrying with it the line $s\ t$ until it stands parallel to the vertical plane of projection, and occupying the position indicated by $g\ h\ i_2\ j_2$, then the line $s\ t$ will occupy the position represented by the line $s_2\ t_2$; since the plane $g\ h\ i_2\ j_2$ now stands parallel to the vertical plane of projection, the line $s_2\ t_2$ must also be parallel to the same plane of projection. If now the line $s_2\ t_2$ (that is, the new position of the given line $s\ t$,) be projected on the vertical plane of projection $A\ B\ C\ D$ we will see the correct length of the given line $s\ t$ (see Art. 242). Here, then, we see plainly the principles upon which the method of finding the length of the line $s\ t$ is based, namely, we simply turn a projecting plane in a position parallel to one of the planes of projection, so as to bring the given line in space also parallel to the same plane of projection, and thus showing its correct length.

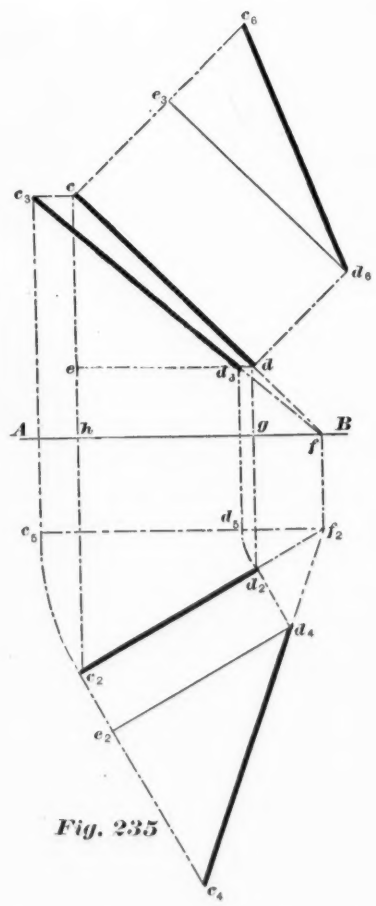


Fig. 235.

334. Let us now compare Fig. 236 with the construction in Fig. 235; in the latter figure the line $c_2\ f_2$ represents a trace of a plane standing perpendicular to the horizontal plane of projection; in fact, the plane represented by the trace $c_2\ f_2$ is a projecting plane; and this plane is swung around a vertical line passing through the point f_2. Assume that this projecting plane has been swung into the position represented by the line $c_5\ f_2$, then this plane will be parallel to the vertical plane of projection, because the line $c_5\ f_2$ is parallel to the ground line $A\ B$; the horizontal projection of the given line $(c\ d, c_2\ d_2)$ in space will then be represented by the line $c_5\ d_5$, and if we now find the corresponding vertical projection, the length of the given line in space can then be obtained by measuring this latter vertical projection. In swinging the projecting plane from $c_2\ f_2$ into the position represented by the line $c_5\ f_2$ the height of the points c and d above the ground line will not be changed, consequently in the vertical projection the paths of the points c and d will be represented by the straight lines $c\ c_3$ and $d\ d_3$. But d_2 and d_3 represent one and the same point, therefore the points d_2 and d_3 must lie in a line drawn perpendicular to the ground line $A\ B$; and since c_3 and c_5 also represent one and the same point, the points c_3 and c_5 must also lie in a line drawn perpendicular to the ground line $A\ B$. Hence the point c_3 obtained by the intersection of the perpendicular $c_5\ c_3$ and the horizontal line $c_3\ c$, and also the point d_3 obtained by the intersection of the perpendicular $d_5\ d_3$ and the horizontal line $d\ d_3$, must represent the extremities of the given line in space when it is placed parallel to the vertical plane of projection; and the line joining the points c_3 and d_3 must represent the correct length of the given line in space which has been represented by the projections $c_2\ d_2$ and $c\ d$.

335. We can also obtain the correct length of the given line by turning the projecting plane $c_2\ f_2$ around a vertical line passing through the point d_2. This will give us a very simple construction, as shown in Fig. 237. Here, then, we have another method of finding the correct length of the given line in space.

336. *Second Method.*—Fig. 237; let $c\ d$ represent the vertical and $c_2\ d_2$ the horizontal projection of the same given line represented in Fig. 235; and assume any horizontal line between the two projections in Fig. 237 to represent the ground line $A\ B$. Through the point c draw a line $c\ c_3$ parallel to $A\ B$; also through the point d_2 draw a line $d_2\ c_5$ parallel to $A\ B$. From the point d_2 as a center and with a radius equal to $d_2\ c_2$, describe an arc cutting the line $d_2\ c_5$ in the point c_5; through c_5 draw a line $c_3\ c_5$ perpendicular to $A\ B$ and cutting the line $c\ c_3$ in the point c_3; join the points c_3 and d, then will the line $c_3\ d$ represent the correct length of the given line in space.

337. From the foregoing we learn that the method of finding the correct length of a given line which is not parallel to either plane of projection, simply consists of turning one of its projecting planes in a manner

which will bring it into a position parallel to one of the planes of projection, carrying with it into the new position the given line in space; and the reason for doing so is simply to bring the given line parallel to one of the planes of projection, so as to enable us to see and measure the correct length of the given line.

338. We also learn that the projection of a line on either plane of projection is less than the line itself, unless the line be parallel to the plane on which it is projected.

339. Since there are two projecting planes employed in projecting the given line, and since these projecting planes can be turned to be parallel to either plane of projection, it follows that there are several other methods of finding the correct length of the given line as shown in Fig. 235, which we shall now explain.

Third Method.—Fig. 235. Let c_2 d_2 be the horizontal, and c d the vertical projection of the given line as before; it is required to find the correct length of the given line by turning the projecting plane which projects the line on the horizontal plane of projection around its trace c_2 f_2, carrying the given line with it until the projecting plane coincides with the horizontal plane of projection.

Through the points c_2 and d_2 draw the lines c_2 c_4 and d_2 d_4 perpendicular to the line c_2 f_2. On the line c_2 c_4 lay off a point c_4; the distance between the points c_2 and c_4 must be equal to the height of the point c above the ground line A B; hence c_2 c_4 must be made equal to c h. On the line d_2 d_4 lay off a point, d_4; the distance between the points d_2 and d_4 must be equal to that between the points d and g; that is, the height of the point d above the ground line. Join the points c_4 and d_4; then the line c_4 d_4 will show the correct length of the given line in space.

In this construction we have turned the projecting plane around its horizontal trace c_2 f_2, and therefore this trace or line is considered to be the axis of revolution (Art. 329). As this plane is revolved about its axis and carrying the given line with it, any point in this line will describe a circle, and, according to Art. 332, the radius of this circle will be equal to a line drawn from this point to the axis, and perpendicular to the latter. Therefore the extremity of the given line in space, or, in other words, the point (c, c_2), when the projecting plane is revolved into its new position, must fall in a line c_2 c_4, drawn perpendicular to c_2 f_2; and the length of the line c_2 c_4, which is the radius of the circle described by the point (c, c_2) must be equal to the height of the point (c, c_2) above the horizontal plane of projection; that is, the line c_2 c_4 must be equal to c h, as we have made it. For similar reasons the other extremity of the given line in space, that is, the point (d, d_2) must fall in a line d_2 d_4, drawn perpendicular to c_2 f_2. If we draw through the point d_4 a line d_4 e_2, parallel to c_2 d_2, then the line e_2 c_4 will be equal to the line e c; that is to say, the line e_2 c_4 will be equal to the difference between the perpendiculars c h and d g let fall from the two extremities of the line c d on the plane of projection.

340. Consequently, when a draftsman finds the length of the given line, he will adopt the simpler method shown in Fig. 238. Here, as before, the lines c d and c_2 d_2 are the projections of the given line; and the mode of finding the length is as follows:

Through the point c (Fig. 238) draw a vertical line c e, and through d draw a horizontal line d e, cutting the former in the point e. Through the point c_2 draw a line c_2 c_4 perpendicular to c_2 d_2 and make c_2 c_4 equal to c e, join c_4 and d_2, then will the line d_2 c_4 represent the correct length of the given line in space.

341. *Fourth Method.*—Fig. 235. In this method the projecting plane which projects the given line on the vertical plane of projection is revolved about its vertical trace c f. Consequently to find the correct length of the given line we proceed in the following manner:

Through the points c and d draw the lines c c_6 and d d_6 perpendicular to c d. Make the length of the line c c_6 equal to that of c_2 h, and the length of the line d d_6 equal to that of d_2 g. Join the points c_6 and d_6, then the line c_6 d_6 will be the correct length of the given line in space. In this construction the line c f is the axis around which the projecting plane is turned, and carrying the given line in space with it, consequently the line c c_6—which is drawn perpendicular to c d—will be the radius of the circle described by the extremity or point (c, c_2) and therefore c c_6 must be equal to the distance between the point (c, c_2) and the vertical plane of projection, and this distance is equal to that between the points c_2 and h. The line d d_6 is the radius described by the other extremity of the line, that is, the point (d, d_2) and consequently the distance between the points d and d_6 must be equal to that between the points g and d_2, which is the distance between the point (d, d_2) and the vertical plane of projection.

342. Drawing through the point d_6 a line d_6 e_2 parallel to c d, then e_2 c_6 will be equal to difference between the perpendiculars c_2 h and d_2 g drawn from the two extremities of the given line to the vertical plane of projection. Therefore, when a draftsman finds the length of the given line, he takes, so to speak, a short cut, shown in Fig. 238; he simply draws through c a line c c_6 perpendicular to c d, and makes the length of the line c c_6 equal to that of c_5 c_2, and joins the points c_6 and d; the line c_6 d will represent the correct length of the given line. The length of c_5 c_2 is obtained by drawing a horizontal line d_2 c_5 through the point d_2 and a vertical line c_2 c_5 through the point c_2, and cutting d_2 c_5 in the point c_5.

343. From the foregoing we learn that when a line in space is not parallel to either plane of projection its correct length is equal to the hypothenuse of a triangle whose base is the projection of the line, and whose perpendicular is equal to the difference between the perpendiculars let fall from the two extremities of the line, on the same plane of projection.

Directions.—In the space marked Prob. 40 draw any two straight lines in oblique positions similar to the positions of the lines c d and c_2 d_2 in Fig. 235; assume these lines to be the two projections of a given line in space. Anywhere between these lines draw the ground line A B. Then find the correct length of the line which is given by its projections. Of course care must be taken that the extremities of the two lines assumed to be projections of a given line will be contained in straight lines drawn perpendicular to the ground line A B. Find the length of the line by all the methods given in Fig. 235, so that when the figure on the drawing board is completed it will resemble Fig. 235.

These constructions should be thoroughly understood, and the principles connected with them committed to memory. These are important constructions, and are often applicable to every-day practice.

Problem 41.

344. PRACTICAL APPLICATION OF PROBLEM 40.

Let Fig. 239 represent the elevation or vertical projection, and Fig. 240 the plan or horizontal projection of a locomotive bumper brace; it is required to find the correct length from c to d.

In a problem of this kind we simply draw the center lines c d and c_2 d_2, and assume these center lines to be the projections of a given line in space, and then find the correct length of this given line by any one of the methods given in connection with Prob. 40. Let us apply the second method given in Art. (336).

Draw the center c d and c_2 d_2, and assume these lines to be the projections of a given line in space. Now since the line c d and c_2 d_2 represent one and the same given line, it is of the greatest importance that the extremities c and c_2 of these lines lie in a vertical line c c_2, and the extremities d and d_2 in the vertical line d d_2. Consequently through the point c, in which the center line c d cuts the circle, draw a vertical line c c_2 cutting the center c_2 d_2 in the point c_2; through the line d, in which the center line c d cuts the horizontal line d e, draw a vertical line d d_2 cutting the center line c_2 d_2 in the point d_2. The points c_2 and d_2 will represent the extremities of the center line c_2 d_2. Through the point c draw a horizontal line c c_5, and through the point d_2 draw the horizontal line d_2 c_5. From the point d_2 as a center, and with a radius equal to d_2 c_2, describe an arc c_2 c_5 cutting the line d_2 c_5 in the point c_5. Through the point c_5 draw the vertical line c_5 c_2, cutting the line c c_2 in the point c_2; join the points c_2 and d by a straight line, then will the line c_2 d show the correct length of the center line of brace, or in other words, the line c_2 d will be the correct length of brace between the two feet.

345. We can find the correct length by the fourth method, given in Arts. 341 and 342, thus:

Through the point c draw a straight line c c_4 perpendicular to the line c d; and through the point c_2 draw a straight line c_2 c_6 perpendicular to the line c_6 d_2. From c on the line c c_4 lay off a point c_4, the distance between the points c and c_4 must be equal to that between the points c_2 and c_6. Join the points c_4 and d, then will the line c_4 d be the correct length of the brace. Of course, if correctly drawn the lines c_2 d and c_4 d will be equal in length.

346. If the center line c_2 d_2, Fig. 240, had been a horizontal line, then the center line c d in Fig. 239 would have shown the correct length of the brace, because in this case the brace would be parallel to the vertical plane of projection, and therefore its correct length will at once be seen without any construction. (See Art. 242.)

Fair of the American Institute.

The American Institute will be opened for the annual exhibition on the 28th of September. This will be the fifty-sixth exhibition of this Institute, whose popularity seems never to wane. Workmen have been engaged for some time past in putting the building in order, and painting it outside and inside. The management has put forth extra exertions this year to secure a fine electrical exhibition; this will be the leading feature, apparently, as it is said the electrical exhibits will occupy one-half the entire space in the building, and will embrace about everything, from toys to electric motors for railways, including the most recent practice in electric lighting. It is intended to make this the greatest exhibition of electrical appliances ever held in this country. The electrical display will be in part historical; that is, while it is expected to embrace the most notable of modern appliances, important inventions of past years will be displayed. The great size of the building will still permit room for all other notable inventions in the mechanic arts. Space is being rapidly taken, and it is expected that it will all be occupied before or soon after the exhibition opens.

President Foster's Address Before the Convention of the N. A. S. E.

We make the following extract from an address delivered by President Frank A. Foster before the convention. It contains a hint as to the objects of the association, and other interesting information:

The history of this order is known to you all, and it is unnecessary for me to enter into all its details, or trace its record. Suffice it to say we are proud of that record, and can point with pride to the advancement which has been made in the standing of our members, and to the high praise accorded us by the manufacturers and business men of the country. Our objects being educational, they commend themselves to our employers, and if we but adhere to the principles of the N. A. S. E., not countenancing any project or enterprise that will interfere between employer and employe, but attend only to the education of our members, we are destined to make a rapid stride to the front as a mechanical organization. In many cities and towns already, no further recommendations are necessary for a position as an engineer, than to be a member of this order. There never was a time in the history of the steam engine, when a thorough, practical education as an engineer was more needed than now, and in our order is the opportunity for the members to obtain the desired knowledge, if they but attend the meetings of their respective associations, and take part in the discussions, where much can be learned of benefit to both the old and the young engineer. As you are well aware, manufactures are depressed, fuel is high, and a giant combination has its mercenary hand on the principal coal fields of the country; therefore it behooves us to be more economical for our employers, and where can we learn to do this but in our associations? The motive power for the industries of the country is becoming more dependent yearly on the economical utilization of steam and fuel. The water powers of the country are nearly developed to their fullest capacity, and where this is not the case, their inaccessibility for manufacturing purposes renders it necessary to resort to steam as a motive power. It is estimated that there are to-day, 100,000 stationary engines in the United States, furnishing 2,500,000 horse-power. It is also estimated that 70 per cent. of the motive power of the States is obtained from steam alone. Eighteen years ago the supremacy of steam power was but two per cent. more than half the total power required for the industrial enterprises of the country. The greatest increase in the percentage of steam power has been within the last ten or fifteen years in the textile manufacturing establishments, partly from necessity and partly from choice. I mention these facts as showing the need of a more practical and thorough education for the engineer. As knowledge is power, those who possess it command the largest salary in the profession and will be reimbursed according to their standing as engineers.

Springs and Equalizers.

The Committee of the American Railway Master Mechanics' Association, on Springs and Equalizers, have sent out, through Secretary Sinclair, the following questions:

SPRINGS.

First Question:—What size of steel do you consider gives the best results in locomotive driver and engine truck springs? It is assumed that crucible cast steel is used, but if not, please state what kind of steel you recommend. Second Question:—What length of spring, from center to center of hangers, gives the best results both for driver and engine truck springs? Third Question:—How many plates should be in each driving spring to carry an eight-wheel passenger engine, with about 56,000 lbs. on the driving wheels, or about 14,000 lbs. on each driver? Fourth Question:—How many plates for engine truck springs with about 34,000 lbs. on truck wheels? Fifth Question:—How much camber or set should such driving and truck springs have when free? How much when loaded with the above weights? Sixth Question:—Do you recommend the same size of steel, and distance between hangers, for all classes of engines, and regulate the capacity by the number of plates, or do you have different sizes of steel to change the capacity? If the latter, please state the advantages of that plan. Seventh Question:—Please state your preference for the attachment of the spring hanger—slot or stirrup—and give your reasons for the preference. Eighth Question:—What is your method of applying bands? What size of iron do you use? and is there any advantage in making the bands wider at the bottom than at the top? Ninth Question:—Have you had any experience in the use of bandless springs?

EQUALIZERS.

Tenth Question:—What is your practice in regard to equalizers for driving springs? Do you recommend a solid bar or one slotted for a post? Please send sketch or blue print showing equalizers and attachment both in the center and to spring. Eleventh Question:—What is your practice in regard to engine truck equalizers? Please send sketch or blue print of equalizer and attachment to truck box and spring. Twelfth Question:—Please send sketch or blue print of what you would recommend as the best form of equalizer and attachment for a mogul or two-wheel truck.

Committee: JOHN MACKENZIE, WM. SWANSTON, J. S. PORTER.

Answers to be sent to JOHN MACKENZIE, Superintendent of Motive Power, New York, Chicago & St Louis Railway, Cleveland, O.

There are engineers who believe that before long railroad rails 100 pounds per yard will be adopted as the standard weight of rail on some of our principal roads. The Pennsylvania Railroad Company is already using 85 pound rail for heavy service on some portions of its line.

The Application of Hydraulics to Cranes in Foundries, Machine, Blacksmith and Boiler Shops.

BY W. H. HOFFMAN.

The use of hydraulic apparatus for lifting heavy materials used in construction has long been in favor with all classes of engineering constructors, and the system is now a standard medium of moving heavy bodies. No modern foundry is without its hydraulic lift for raising the pigs to the cupola door, while all our large steel plants have numerous vertical hydraulic cranes for handling the material hot and cold.

The type of hydraulic jib crane usually found in the steel and iron rolling mills, can be used in an ordinary foundry to advantage, where the reach of the jib is not required to be more than 9 feet, and the lift not over 8 feet. The lifting capacities of these cranes depend entirely upon the manner of distributing the metal, and the arrangement of the ram in connection with the water cylinder and jib.

When this style of crane is adopted for foundry service, and they are arranged to make a complete circle in traversing, the lifting power is limited, but if they are to be used as wall cranes, the lift can be increased by adding an upper guide for the top extension of the ram. The central location, however, is the one most desired for a hydraulic loading crane, and it must be self-sustaining under its load; there are several methods of accomplishing this result. The single ram, with rising post and jib combined, is the most common design, but I have designed cranes of this character using the double or telescopic ram, in order to increase the stiffness of the ram post and to provide two separate lifts, in power and travel.

The accompanying sketch, Fig. 1, will be understood by those interested. Referring to the sketch it will be seen that the water is carried to the inner water cylinder, through the outer one, in a turned pipe, and each ram has an upward and downward movement of 4 feet. From four to five tons can be handled on a crane of this kind with perfect control of every movement, as the traverse as well as the vertical motion is operated by water pressure, a simple piston motor being connected to the traversing trolley. A water pressure of only 75 pounds per square inch is required for both rams. In operating, the valve connecting the induction to the small ram cylinder is moved first, thus starting the load at a low velocity, and when near the finish of its lift the valve leading to the large ram cylinder is auto matically opened, thereby increasing the speed of the last four feet of the lift. A clip on each ram prevents its going beyond the stroke terminus.

The jib is made of steel plates riveted to a cast-iron sleeve, turned to fit the upper ram, while the lower end of the sleeve travels on anti-friction rollers placed between the sleeve and a collar on the ram. All things considered, this crane will cost no more than a regular post power crane, and if steam engines are used for power, it will cost much less than the latter style, while the convenience in operating and the extra clearance in hoist is far superior to any of the old systems. The gain in clear hoist is very great, and power can be used for traversing the crane in its circle if desired, with little additional cost.

For forging shops fitted with steam and other power hammers, this crane is a most valuable appliance.

This particular style of hydraulic crane was designed by the writer for a loading crane for foundry use, and is intended to take the castings or heavy iron flasks from the foundry railroad truck, and deliver them on a wagon or heavy hauling truck. It will be seen that the lifting is all done quite near the center of the rams, and the load is then run out on the jib if necessary, to suit the position of the wagon.

The water valves are connected to starting levers conveniently placed near the ram, one lever operating all the valves when coupled together, or only two valves when each ram is moved independently of the other. Only one person is needed to load or unload any piece weighing four tons, and the crane can be used in the machine shop for the same duty, though it is not adapted to general hoisting in this department.

Fig. 2 represents a hydraulic yard crane or derrick, also designed by the writer, steel and iron being the only materials used in its construction. It has a clear hoist of 16 feet, a reach from the center of 18 feet 6 inches, and it will lift twenty-five tons. The water cylinder is placed in a water-tight well, the stroke of the water piston being twice the hoist of the lower block. The trolley is traversed by a separate water motor, and the turning of the jib is accomplished in the same manner. All the motions for operating the crane are worked from a platform, situated about 7 feet from the ground, and all pipes and cylinders are protected from frost. The jib makes a complete circuit on four wheels, each 2 feet in diameter, all traveling on a flat table, while at the top of the jib casting are placed four other wheels in the rear of the jib spindle, and which travel on the outer surface of the spindle, thus reducing the friction to a minimum. These wheels are each 14″ in diameter.

A bevel gear and pinion conveniently placed in connection with the main jib casting furnishes transmission for revolving the jib on its spindle, the gears being operated by the motor. The jib arm or truss is made up of steel plates riveted and bolted together. The hoisting rope is of the best cast-steel, 1⅛ inches in diameter, and the rope sheaves are 56″ in diameter. This crane is designed to be used in the machine shop yard, and near the erecting shop doors.

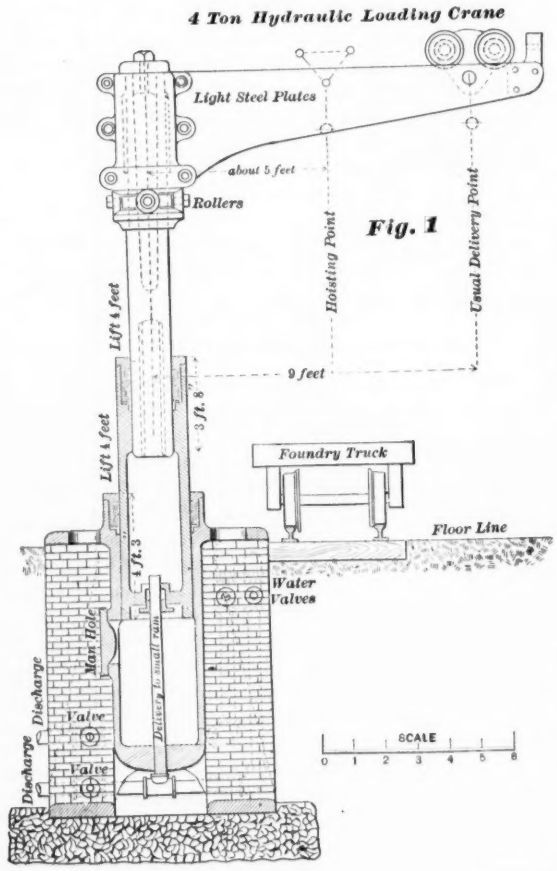
Small lifts on the single direct lifting plan (without jib) are well suited to the boiler shop, for raising plates from the floor level to the level of the punching, shearing, or planing table. In fact, the boiler department is one that has many uses for hydraulic power, not only for manipulating the material, but for handling it with rapidity.

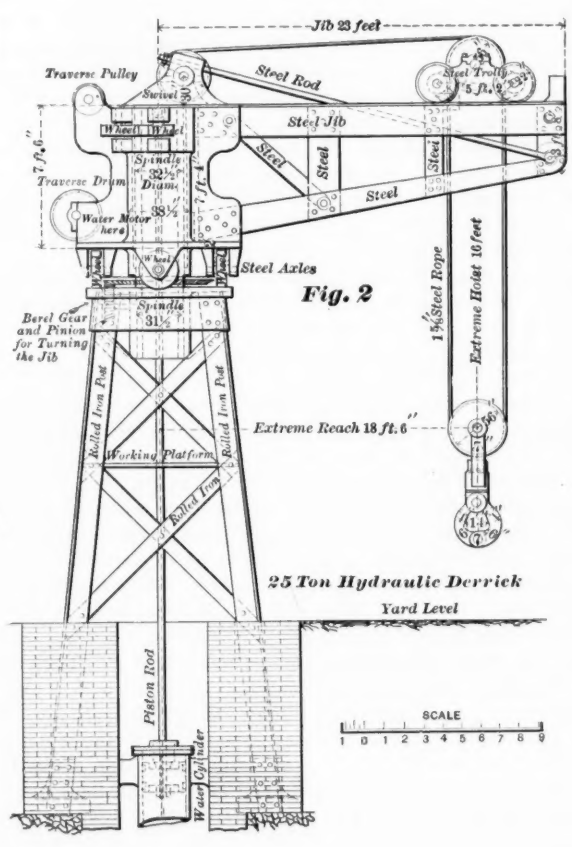
The builders of hydraulic boiler tools have invented and placed in the hands of our boiler makers many ingenious tools, but the builders of hydraulic cranes have not, we think, contributed their share of boiler shop appliances; if they have invented them they are certainly slow in introducing them.

Most of our large machinery factories are located in or near some large city or town which is usually well supplied with water, under pressures varying from 70 to 250 pounds per square inch, so that no pumping machinery is needed to furnish hydraulic power for cranes, etc.

If water is not to be obtained from such a source, it is quite an inexpensive matter to arrange a pumping plant, capable of supplying all the lifting and working power required. The first cost of a complete hydraulic equipment is of little consequence, compared with the advantages derived from this system, and no large machine shop or foundry can well afford to be without hydraulic cranes.

4 Ton Hydraulic Loading Crane





HYDRAULIC CRANES.

According to the Oil City *Derrick* there are more than 34,000 miles of tubing used in the oil wells of Pennsylvania. At 15 cents a foot this tubing would cost $29,000,000. It would require, allowing 40 feet to the well, 31,000,000 of 5⅛ inch casing, which at 50 cents per foot, would amount to $15,750,000. Allowing an average of 100 feet of drive pipe to a well it would require 7,000,000 feet, and cost, at $1.40 per foot, $10,000,000. It would take $7,000,000 worth of lumber to build the rigs, and the machinery and boilers necessary would cost $20,000,000 more, making a grand aggregate of $80,850,000.

As recorded by our correspondent, a factory is about to be established at Mobile, Ala., for the manufacture of cheap furniture. At Mobile such an enterprise is an experiment, but at several other Southern towns it has passed beyond the experimental stage. It has come to our knowledge that there are makers of low grade furniture in the South who have made money rapidly. The South calls for more cheap furniture than any other section of the country, and in no other section can timber suitable for such furniture be bought for so little money. It follows, therefore, that cheap furniture should be manufactured in the South. To pay higher prices for lumber North, manufacture the lumber into furniture, and then pay for transporting the furniture to the South, where it is wanted, is certainly very poor economy. The establishing of cheap furniture factories in the Southern States has been advocated in these columns for years. There is room for more such factories, and wide-awake men should avail themselves of the chances.—*Northwestern Lumberman.*

Engineering Department of Vanderbilt University.

We have received from Olin K. Landreth, dean of the engineering department of Vanderbilt University, Nashville, Tenn., some facts in relation to that university. Owing to most liberal endowments of the Vanderbilts, tuition in the regular and complete courses of engineering—civil, mechanical and mining—is made extremely low, while instruction in manual technology and highway engineering is free of charge. We extract from the circular the following in reference to manual technology. It will be seen that—wisely we think—while no claim is made of turning out skilled artisans in a few weeks, yet the advantages of this course are made perfectly apparent:

The purpose of the organization of the other branch of instruction—viz., manual technology—is to supply a course of mechanical instruction shorter and more elementary in character than the regular courses in engineering, but comprising studies and practical work so related as to be, for its scope, fairly complete in itself, and to constitute a valuable preparatory training for young men who intend to become skilled artisans, designers, constructors, managers or superintendents of mechanical operations and enterprises, as well as for those who, recognizing the educating value of a rational system of manual and mechanical training, desire such a course as a part of their general education. The plan of instruction comprises a foundation of the principles of mathematics, physics, mechanics and drawing, on which is given thorough instruction in the proper application of these principles to the more prominent constructive operations and mechanical trades, illustrated and put into execution in the draughting rooms and shops.

The prime object of the course is to teach young men the habits and methods of doing whatever they undertake thoughtfully and rationally, to train them to think about their work, and to work as their thoughts direct, to know the reason, and to have a definite object for every step taken: in short, to install the mind, properly trained, as the ruler of the hand, and to teach it to guide, to ease, and to render more efficient the efforts of the hand.

The course extends through two years, and unites contemporaneously class instruction and shop work in subjects closely related.

The forenoons are devoted to class work and draughting, and the afternoons are regularly assigned to the several shops in exercises three hours in length.

It should be added that the privileges of this university are free to all, without limit as to what part of the country they live in.

To Give Great Hardness and Ductility to Red Brass.

In order to make an alloy which gives great hardness and ductility to red brass, without having recourse to phosphor bronze, a mixture of green bottle glass is recommended to be added to the other metals. To this end a pound of finely-pounded glass is to be added, say to a 50 pound crucible charge, or two per cent., care being exercised to place the whole quantity of the glass at the bottom of the crucible, while the other metals are on the top. The brass obtained is exceedingly hard, and is not easily worked, but the alloy is valuable as a

mixture in making other qualities of brass, for which purpose borings, filings, etc., can be used up with advantage. If the above alloy is to be used for parts of machinery, and to be tooled, one per cent. of oxide of manganese should be mixed with the metal to be melted. All sorts of brass made with this alloy are very liquid and close grained. Porous castings become almost an impossibility when the alloy is used, even when cast in green sand.—*Engineer and Iron Trades Advertiser.*

Ethics in a Machine Shop.

BY JARNO.

II.

First.—After considerable progress in some branches of knowledge, or of science, it has been found convenient, and perhaps necessary, in order to satisfy the mind, or in order to make a connected chain of reasoning, with a view to future progress, to go back and make an assumption, or form a hypothesis upon which to base an explanation of facts already noted. In astronomy there is the nebular hypothesis. When there is a large preponderance of facts under which to suppose a groundwork, so that it is more universally acknowledged, it becomes more than a hypothesis, and is then called a theory. Thus we have the theory of the atomic or molecular vibration of matter to explain the phenomena of heat.

The basis of all I say about machine shop ethics may be found when we answer the question: What, in the light of all that was said or written, and of all the facts known by either party, would be the sober decision of men?

I see a machine in the shop where it was manufactured, with skids attached, standing on the floor, as if just being prepared for shipment.

This machine was turned out several years ago, and does not contain the latest improvements. Having become somewhat stained and rusty in the salesroom, it has been returned to the shop, and has been re-scraped and polished up. Now, to sell me this machine, without giving the foregoing facts, may be a legitimate transaction, but it is not ethical.

A legitimate transaction is one that comes entirely within legal restrictions—one where nothing can be found that does not conform to what was actually spoken or written in relation to the transaction. In the world of trade it is considered legitimate to answer no questions that are not asked. Yet a machine may be seen under circumstances where questions would not naturally be asked; and unless the seller clearly states the facts, deception may be as complete as if verbal misrepresentation had actually been made.

It may be legitimate not to call attention to features that might be objectionable so long as the buyer sees the machine at the time of purchase, and is at liberty to examine it all he pleases; yet, as before, when this machine does not represent the latest product the transaction is not ethical.

An ethical transaction is one where due effort is made to have each and every party know all that any or either party knows.

I have reason to believe that the machine contains the latest improvements, because it is apparently a new machine, and because I see it in the place where new machines are expected to be seen. The seller knows all this, and takes advantage of it. In so doing, while he may be standing squarely upon a legitimate plane, he is in a position considerably below an ethical plane.

In general, I would say that when a man, in telling how smartly he conducted a legitimate transaction, puts a knowing wrinkle on one-half his forehead and smiles, he himself knows that his acts will not stand an ethical test.

Second—When a boy I knew a machine shop where two pieces, each for exactly the same purpose, were made of different weights, the heavier piece to be sold by the pound and the lighter one to be sold by the piece. I have since heard that the same thing was done in other shops. It might have been said that competition or the exactions of customers compelled the adoption of such an expedient. I doubt the expediency. I have that faith in our times to think that a machine shop could not well adopt a more fatal method of suicide. So far as I know, all these shops have gone the way of those not fit to survive. If any yet

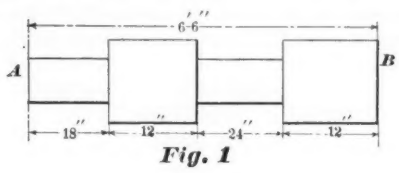


Fig. 1

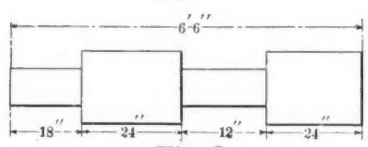


Fig. 2

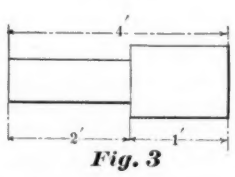


Fig. 3

remain, no doubt the eliminating process of evolution will soon carry them out. It is encouraging to note that for many years the tendency has been to make machinery abundantly heavy and strong, and at the same time not to sell it by weight. I fear that a return to the custom of selling machinery by weight would be a clog to ethical progress.

Third.—There is a class of cases akin to that given in the first part of Art. I, where there is a mistake in the drawing and the conditions of the order cannot be met. A party sent a sketch, Fig. 1, above, with an order for a cylin rical piece or shaft.

Starting at *A* the piece was forged and the measurements stepped off in order. When about to cut the piece off at *B* it was seen that the sum of the parts, as figured, was not equal to six feet and six inches. There should have been two twenty-four inch measurements and one twelve inch measurement, as in Fig. 2, and not two twelve inch measurements with only one twenty-four inch measurement, as in Fig. 1.

A new shaft had to be made. The forger claimed that both shafts should be paid for because the drawing was figured wrong, the mistake having been made by the party ordering. On the other hand it was held that the mistake in figuring was so palpable that the forger, by due attention, should have seen it; that the forger had attempted an absurdity because it was impossible to make a piece that would correspond to all the figures.

The principle was laid down that a man should not be paid for making one part of a piece two feet long, and the remaining part one foot long, with the expectation that the whole length of the piece would be four feet, as is called for in Fig. 3; that Fig. 1 was merely a combination of parts like Fig. 3; that to attempt to work to such drawings was as absurd as to try chucking an eight inch hole through a seven inch pulley. The forger reluctantly consented to render a bill for only one shaft. This may appear to have been a clear case against the forger—that he should not be paid for attempting to make two and one equal to four, nor for attempting a more complicated absurdity in addition. Yet a rigid analysis of the spirit of this reasoning drives us to holding a machine maker responsible for mistakes in drawings which customers send him to work by, unless he discovers the mistakes before starting on the work. Then it directly follows that he must examine and check all drawings sent to him with orders.

Is is difficult to establish a principle which will always indicate the ethical limits in such cases. If the forger attempted an impossibility, the orderer pointed the way. I think we can establish this principle: Wherever we draw a line, and however fine the line may be, we shall find cases exactly on the line, and whatever the reasoning may be in making a decision it can hardly be expected that both parties will see alike.

An acknowledgment of this principle will often go far towards an amicable adjustment of differences. Admitting that at times we must differ, it is a part of true culture that we do it courteously and without heat.

Both Sides.

BY ROBERT E. MASTERS.

Wooden patterns that are in two or more parts are usually fitted together with hard wood dowel pins, and fit first rate when they come from the pattern room. But after being in use a short time, the moulder finds the wood has swelled from being constantly in the damp sand, and not being able to "get a good lift because the cope piece of the pattern has stuck down," the dowel pins are cut down by the moulder until the upper half of the pattern has $\frac{1}{8}$″ or more play; but then you know the moulder feels sure the upper half of the pattern will lift with the cope, and he is more astonished than anybody if the casting shows a lap (or "shift") that almost, if not altogether, condemns it.

A few firms use plates and pins on their patterns, as in Figs. 1 and 2. These are made in sizes to suit the patterns; the small sizes are made of brass and the large ones of cast-iron. The plates are set in flush with the pattern, and as there is no trimming down required in the foundry there is no danger of a shift in the pattern, and a good joint is obtained.

Fig. 1 of wrought-iron answers for a rapping plate; on light patterns these plates are sometimes made long enough to reach across the pattern. They have rap and draw holes in them, and where the pattern is not thick enough to use screws they are fastened with copper rivets. This keeps the pattern straight and gives the moulder a chance to get it out of the sand. In large heavy patterns, rapping plates, like section and top view, Figs. 3 and 4, made to correspond with the pattern, and being put in suitable places, prevent it from being knocked to pieces when ready to draw.

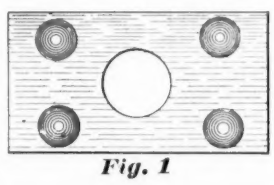


Fig. 1

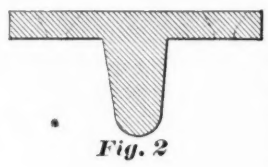


Fig. 2

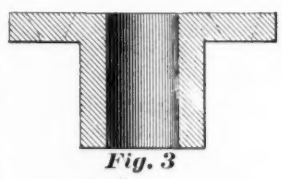


Fig. 3

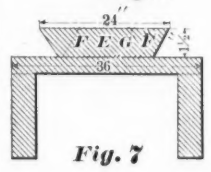


Fig. 7

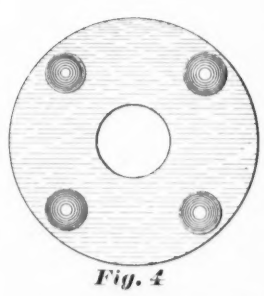


Fig. 4

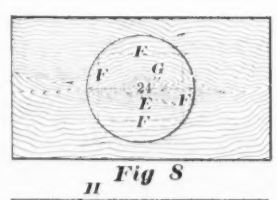


Fig 8

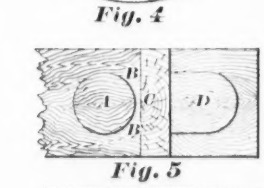


Fig. 5

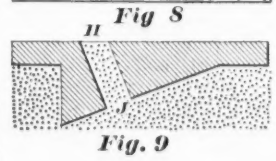


Fig. 9

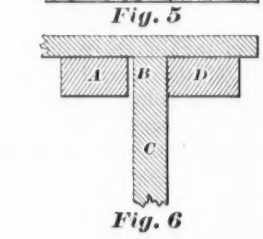


Fig. 6

PATTERN FIXTURES.

A foreman of the pattern room in a large establishment doing general and special work when making patterns that are to be in constant use on the floor, and are too heavy to make of all brass or iron—take for example a car journal box or a draw head—employs the following plan: A frame $\frac{1}{8}'' \times 1''$ the shape of the outside edge of the pattern is cast in one piece, and of brass; the rap and draw plates are heavier and are cast on the frame. These are fitted into and screwed fast around the edge of the pattern. One of these each on the cope and drag half of the pattern binds the patterns together, gives a good joint, keeps the edges from being broken, and prevents the moulder from cutting the edge of the pattern away with the trowel when dressing up the mould.

The moulder owes much to the pattern maker for the skill and ingenuity exercised in getting up patterns so that the mould can be made conveniently and speedily. The great drawback the pattern maker has before making the pattern is there are comparatively so few moulders who can read a drawing well enough to give an intelligent idea of how the pattern ought to be made from the drawing. This forces the pattern martyr to do the best he can on whatever knowledge he may have of moulding, and the moulder will discover a mistake in an instant after all the work has been done on the pattern; it is then too late. It would be well if some of these after-thinkers in the foundry would apply themselves to it and learn how to read a drawing, or make room for those who know how to have the work done right before all the time and labor is lost.

Occasionally pattern makers make blunders that make the moulders feel like consigning them to a place where the water never congeals and there is no use for club skates. A pattern is made with a number of core prints of different shapes, and the moulder can't get the cores in the prints without a good deal of filing, and fitting, and crushing, and mending, simply because the core boxes have been made exactly the same size as the prints—a mistake common among pattern makers. I asked Mr. J. H. Goode, a practical pattern maker in charge of the pattern department of the C. and O. R. R., what system he used in making core boxes. We make tons of all classes of castings for them every day, and have never had any trouble about the cores fitting nicely. He said he made the core prints by the shrinkage rule and the core boxes by the common rule.

In Figs. 5 and 6 the core print *A*, *A* will show the style employed by many pattern makers to core a round hole by the side of a bracket, leaving a feather edge of sand at *B*, *B* on the edge of a deep place in the mould as at *C*, *C*. If there is only one casting to make the moulder can use a plain round core if the pattern will not leave its own core of green sand; in this case where there are a number of pieces wanted Mr. Goode's plan is to make a special core box with the bottom print shaped as at *D*, *D*.

I was in a foundry not long since when a pattern was brought in like Figs. 7 and 8. The piece *E*, *E* was dovetailed, as the casting was intended to be when finished in the machine shop, and it was nailed fast to the pattern. The foundryman pulled the piece *E* off and sawed it through as shown by the dotted lines *F*, *F*; this was lifted off in the cope and the square in the center *G* drawn out and the rim pieces drawn in. The foreman said it was an everyday affair to get patterns like that, and showed Fig. 9 which had been sent down a day or two before. A rib running between the angle washers like the one shown in section (one at each end of the plate) prevented the moulder from making this on an angle that would

let the cores *H* draw. The pattern maker could have saved himself time and the foundry trouble if he had made the pattern solid and put a loose print on at *J*, or if he had furnished a plug with a shoulder on it for the moulder to push through the holes and make his own prints before drawing the pattern.

One would hardly expect to find mistakes like these on either side, but their name is legion.

Fire at the Grant Locomotive Works.

On the morning of September 7th, a fire was discovered in the silk mill which occupied a part of one of the upper floors of the Grant Locomotive Works, Paterson, N. J. The result of this fire was the destruction of the oldest portion of the Grant Locomotive Works, in which, under the able management of Mr. D. B. Grant, were built some of the finest locomotives in this country. Among these was the locomotive "America," which took the gold medal at the Paris Exposition in 1867. Indeed, in this portion of of the works the company gained for itself their world-renowned reputation. In the upper part of this portion of the works, and directly under the silk mill, were situated the brass finishing room, bolt room, tool room, and another room filled with templets and machinery for finishing the lighter parts of locomotives. The ground floor below these rooms was filled with heavy machinery used for planing and slotting the locomotive frames, for finishing the main and side rods, and for finishing other heavy parts of locomotives. The brass finishing room, bolt room, tool room, and a portion of the same floor, were completely destroyed, the machinery in these rooms falling and covering up a great number of the machines on the ground floor. The roof of this part of the works is completely gone, leaving part of the eastern wall standing. The fire extended to the machine shop above the main erecting shop, which has been lately rebuilt. Here the fire damaged the roof, and the machinery was damaged by water only. In the main erecting shop were six locomotives in various stages of construction; one was completed; some nearly so. These locomotives were only slightly damaged by water. In the rear erecting shop, which contained two locomotives almost finished, and also heavy machinery for turning and boring tires, wheel centers, and for doing other heavy work, the only damage sustained was that by water. The most serious loss to the company, and which they will feel severely, is the loss of all the general plans of locomotives and a portion of the detail drawings—indeed, the most valuable drawings—which have accumulated for years, and which cannot be replaced at any expense or under any circumstances. The occurrence of this fire is a most unfortunate one, since it throws out of work about five hundred and fifty men, and on account of the fact that these works have only lately resumed work after a prolonged and enforced idleness it will be severely felt by the employes. We hope that the old time energy of this company will assert itself, and the rebuilding of these shops will be commenced at once.

A heavy steel casting has just been completed in Sheffield, which, it is said, is probably the heaviest ever made in England. The diameter of this casting is 62 inches, and its weight 70 tons. The heating operation lasted over sixty hours, and when the glowing mass glided out of the furnace the ingot with porter-bar and balance-weight made a total weight carried by the crane of at least 120 tons. This ingot was pressed into shape in a 3,000-ton forging press.

We see it stated that a stock company has "taken hold" of the Normal College at Flint, Mich. If the college would only tackle two or three stock companies it might be better. As it is, we fear the college will be shaken up, that is, if the company gets a good hold.

LETTERS FROM PRACTICAL MEN.

The Spring Roller Problem Again.

Editor American Machinist:

In reference to the article by Prof. Sweet in the AMERICAN MACHINIST of Aug. 20th, in relation to cylindrical springs or spring rollers, I submit the following:

Fig. 1 is a section of a spring roller with dimensions designated by letters; and the rest of the factors necessary for the calculation of the thickness *T* are expressed by letters as follows:

W = the weight which the spring has to carry.
S = the deflection caused by this weight.
E = the modulus of elasticity.

$$\text{Then } T = D \sqrt[3]{\frac{.2232.\ W}{E\ B.\ S}}$$

D means a diameter taken at the center of the thickness of the roller, and measured on its largest diameter when deflected to one-half the amount called for. This distance can of course not be given correctly before the thickness is known, but any good mechanic can guess at it with sufficient accuracy, and besides, the calculation will show whether any great mistake has been made, and if so, the correct value of *D* may be substituted.

In applying this formula to Prof. Sweet's springs it will be necessary to know the modulus of elasticity, which varies for different kinds of steel, forging and tempering. Supposing $E = 30{,}000{,}000$, then we have for $B = 1\frac{7}{8}''$, $D = 3\frac{1}{32}''$, $W = 750$ lbs. and $S = \frac{1}{16}''$ as given by Prof. Sweet.

$$T = .1234 \text{ inches.}$$

The exact value of *E* can be obtained when a ring is made of any diameter and thickness, and it is known how much it will spring under a certain weight, by substituting these known quantities in the formula, which then will be

$$E = \frac{.2232\ W\ D^3}{B\ S\ T^3}.$$

As it may be of interest to some of your readers to know how I came by this formula, I will explain it here.

Fig. 2 is a steel ring with a weight *W* applied to the top. This weight will change the shape of the ring as shown much exaggerated in dotted line. It is obvious that the top and bottom part will be straighter, and the sides more curved than before compression. That is to say, the top and bottom part will stretch on the inside, and the two intermediate parts will stretch on the outside. Accordingly there must be four points where the ring is not bent at all, where there is no unequal tension in the cross-section of the metal. That is to say, four points where, in this case, we may consider the ring as without any tension at all, where the steel will be found in its natural condition as before the weight was applied. We may, therefore, cut the ring through at these four points, while the weight is on it, without thereby changing its shape. Or, we may take the four pieces apart and apply half the weight *W* to the ends of each piece, as shown in Fig. 3; the shape of the several pieces will then be exactly as before cutting. We will now take one piece, for instance, *U*, Fig. 3, cut it through in the center, and fasten one-half to a solid standard, as shown in Fig. 4, with the weight $\frac{W}{2}$ applied to the end. The deflection of this piece will then be exactly like the deflection of the corresponding part of the ring; for the only difference in the conditions in Fig. 3 and 4 is this, that in Fig. 4 we have a piece securely fastened to a standard, while in Fig. 3 we have it fast on the other half, and the whole kept in balance by an equal weight on the opposite end. Fig. 5 shows half the piece treated in the same manner with the same result.

The problem is now reduced to its simplest form; that is, to calculate the deflection of a flat piece of steel fixed at one end and with a weight applied to the free end. Formulas for the deflection of straight beams in horizontal positions can be found in almost any pocket-book for engineers. These formulas always contain the third power of the length of the beam. If we for this factor substitute the square of the horizontal projection multiplied by the actual length of the beam we get a true formula for the vertical deflection of a straight beam in a position inclined to the horizontal, and it will be very nearly correct for a slightly curved beam. The formula for a straight horizontal beam, fixed at one end and loaded at the other end, is

$$F = \frac{L^3\ W}{3\ E\ I}$$

where *F* is the deflection of the free end; *L*, the length of the beam; *W*, the load; *E*, the modulus of elasticity, and *I* the moment of inertia of cross-section. For a straight beam in an inclined position with a horizontal projection *P*, as shown in Fig. 6, this formula becomes

$$F = \frac{L\ P^2\ W}{3\ E\ I}.$$

As the projection *P* increases when the beam is bent, this formula is not altogether correct, but is very nearly so when the deflection is comparatively small and *P* is taken a little longer than the actual projection *P*. In applying this formula to a ring we may imagine it divided into eight equal parts, and calculate the vertical deflection of two of them in the positions

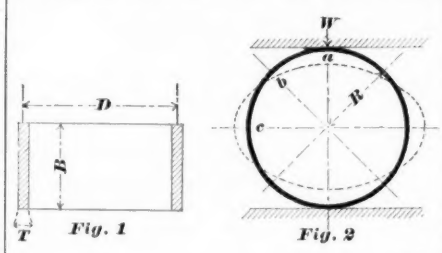


Fig. 2

Fig. 1

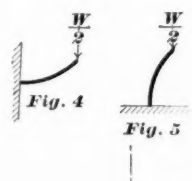


Fig. 4

Fig. 5

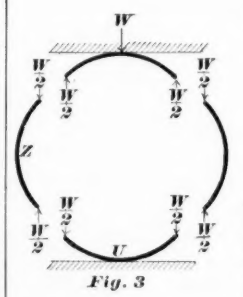


Fig. 3

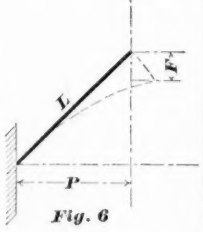


Fig. 6

shown in Figs. 4 and 5. The sum of these deflections will be half the deflection of the ring. The horizontal projections will be found by an inspection of Fig. 2, to be $R\ V\frac{1}{2}$ and $R - R\ V\frac{1}{2}$ for curves *a b* and *b c* respectively, which, according to the formula for beams in inclined positions, gives

$$S = \frac{(2 - V2)\ \pi}{96}\ \frac{W\ D^3}{E\ I}$$

where *S* is the deflection of the ring.

And, as

$$I = \frac{T^3 B}{12}$$

for a rectangular cross-section, we have

$$S = \frac{(2 - V2)\ \pi}{8}\ \frac{W\ D^3}{E\ B\ T^3} = \frac{.23012\ W\ D^3}{E\ B\ T^3}$$

and

$$T = D \sqrt{\frac{.23012\ W}{E\ B.\ S}}$$

According to this formula Prof. Sweet's spring roller would be .1247 inch thick. A more correct formula can be found by integration, but the difference is very small, as will be seen by comparing the thickness just found with the thickness first given, which is calculated from the more correct formula.

The formula just found is not quite correct, for two reasons, first, because the points of no tension do not divide the ring into four equal parts, although very nearly so; secondly, because they are not straight, but curved pieces we have to do with. I shall now shortly explain how a more correct formula can be found by integration.

The exact location of the neutral point *b*, Fig. 2, may be found by the following argument:

As the tangent to this point is common for both curves *a b* and *b c* before and after deflection it is evident that the angles between the tangents to the extreme points of the curves, Figs. 4 and 5, before and after the weight is applied, must be the same for both curves. This angle, which we may call the angle of deflection, is equal to the sum of the products of the moments of bending, and an indefinitely small part of the length of the beam divided by the modulus of elasticity and the moment of inertia. The moment of bending or moment of flexure is the weight multiplied into an arm *A*, which is variable and equal to the horizontal distance from the free end to any point on the curve. This is expressed in the following equation:

Angle of deflection

$$= \frac{W}{E\ I} \int_0^L A.\ d\ x$$

where $d\ x$ is an indefinitely small part of *L*. In Fig. 2 we have the length of the curve $a\ b = L$, and when any part of *L* measured from *a* is designated by *x* we have

$$A = R \sin \frac{L}{R} - R \sin \frac{x}{R}$$

and consequently

Angle of deflection

$$= \frac{\left(\frac{W}{2}\right)}{E\ I} \int_0^L R \sin \frac{L}{R} - R \sin \frac{x}{R}\ d\ x$$

$$= \frac{\left(\frac{W}{2}\right) R^2}{E\ I} \int_0^L \sin \frac{L}{R} - \sin \frac{x}{R}\ d\ \frac{x}{R}$$

In like manner we get for *b c*

Angle of deflection

$$= \frac{\left(\frac{W}{2}\right)}{E\ I} R^2 \int_0^{\frac{\pi}{2}} \frac{R - L}{\cos \frac{x}{R} - \sin \frac{L}{R}}\ d\ \frac{x}{R}$$

and from this we deduce sin

$$\frac{L}{R} = \frac{2}{\pi}$$

$$L = R \sin^{-1} \frac{2}{\pi}$$

The next problem is to find the vertical deflection, which is equal to the sum of the products of the moments of bending squared, and an indefinitely small part of the length divided by the weight, the modulus of elasticity and the moment of inertia.

This is, in a modified form, expressed in the following formula:

$$F = \frac{W}{E\ I} \int_0^L A^2\ d\ x$$

where *F* is the vertical deflection of the free end, and *A* is the variable arm, which, multiplied into the weight *W*, gives the moment of bending. Calling the vertical deflection of *a b* and *b c*, respectively, F_1 and F_2, we have

$$F_1 = \frac{\left(\frac{W}{2}\right) R^3}{E\ I} \int_0^{R \sin^{-1} \frac{2}{\pi}} \left(\frac{2}{\pi} - \sin \frac{x}{R}\right)^2 d\ \frac{x}{R}$$

and

$$F_2 = \frac{\left(\frac{W}{2}\right) R^3}{E\ I} \int_0^{R \left(\frac{\pi}{2} - \sin^{-1} \frac{2}{\pi}\right)} \left(\cos \frac{x}{R} - \frac{2}{\pi}\right)^2 d\ \frac{x}{R}$$

from which we deduce

$$S = 2\left(F_1 + F_2\right) = \frac{W\ D^3}{8\ E\ I}\left(\frac{\pi}{4} - \frac{2}{\pi}\right) =$$

$$\frac{.2232\ W\ D^3}{E\ B.\ T^3}$$

and

$$T = D \sqrt[3]{\frac{.2232.\ W}{E\ B\ S}}$$

J. BEGTRUP.

[It is contrary to our general policy to admit the higher mathematics to our pages, but, for obvious reasons, we waive our rule in this instance.]

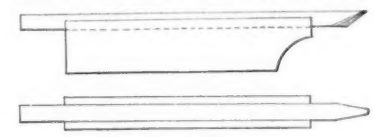
Square Driving Centers.—Tool for Small Lathe.

Editor American Machinist:

It is astonishing how little a square driving center is used in a machine shop, when it is considered how handy it is. I had worked some years at the business before I knew anything about its value, and I am under the impression that there are many brother chips who have never tried it. The way I was finally enticed into using it was thus: There were a number of small pieces cast without the customary shank for dogging, and it was proposed to follow the usual plan, viz.: throw them away. I had seen small brass work with square center ways, but had never given the matter a thought. But it occurred to me that this would be a good time to see if there was any value in such a means of driving. I made a square center and used it for the job, and afterwards would as soon have thought of getting along without a hammer. Using this center, short work can be cut to right length; no dog to bother, or to cause chattering. Just have a center punch shaped like the center, then after drilling centers in the pieces a blow or two make the center way all right. It is surprising how strong such a center will drive. The taper on the center should be long, as shown in the sketch.

The sketch of lathe tool explains itself. I have found it one of the best conveniences I ever had around a lathe, for light work. You can get a bar of square steel and soon have a box full of handy tools without a ton or two of metal lying about. It is not necessary to draw down a large bar of steel to get a small pointed tool. You can heat by gas, or shape in a vise, and get just such a tool as you want. In fitting out a lathe with tools but few large ones will be required if a device like this is made.

MACHINIST.



LATHE TOOL.

SQUARE CENTER.

Improving Plug Cocks.

Editor American Machinist:

I suppose every engineer in the country has wrestled with plug cocks. They are handy in many places, but you cannot set one so it will turn twice alike, owing, perhaps, to unequal expansion, and the result is they always leak, and cut out from turning in a short time if used much. The outcome is the plug cocks are taken out and replaced by something not half as handy for the purpose.

I had some plug cocks that were so located that I could not well use any other kind of valve. They were exposed to quite high and considerable changes in temperature, and leaked so as to be a nuisance. I got some new shells and sweat caps on the small end, as shown in cut, and cut fine threads on the large end. Then I made spanner nuts, and to pack I cut thick rubber gaskets (the plugs projected $\frac{1}{16}$" beyond the shell) to fill the space as at *P*. This packing forms a spring to keep the plug in place, and the cocks have never leaked a drop since I rebuilt them.

If manufacturers would make plug cocks something like this I am certain more of them would be used.

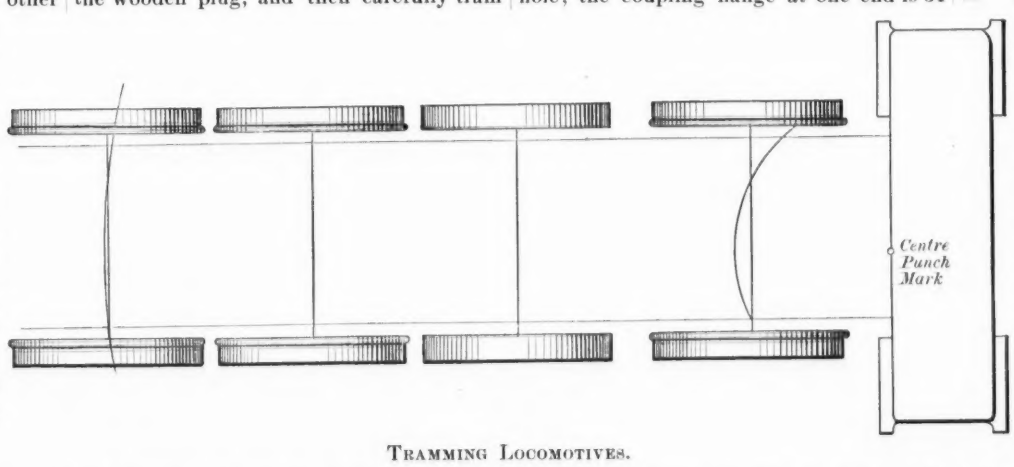
ENGINEER.

Tramming Locomotives.

BY JOHN A. HILL.

A few weeks ago I wandered into a small round-house, where the foreman was personally superintending the tramming of a consolidation locomotive that was cutting her front tire on the left side. I knew him slightly—knew him five years ago, when he came out of a coal mine to watch a construction engine. He came over to where I was standing, and said: "I am having a whale of a time with that engine, or rather with the man that runs her; he says she is 'out,' because she crowds to the left; but, bless you, she is as square in her frame as I am. I think it is the way her flanges are turned, or her spring saddles set; but she is square, see!" And he put the straight end of his tram against the back end of the cylinder head (both back heads were off), and put the movable tram point into a delicate prick-punch hole in a lead center in the driving axle. Then he went around to the other side, and placed it in the same position.

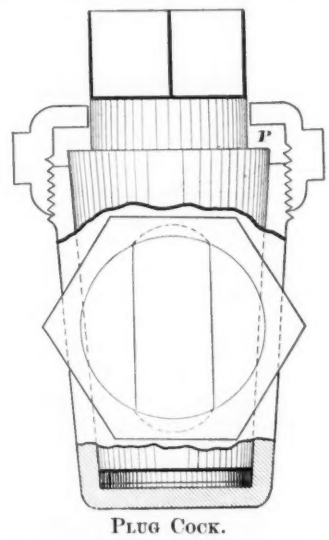
I found out that this was his way of tramming all the locomotives that were supposed to need it—new as well as old engines getting the same. He informed me that this was the proper way, as the back head was of necessity right—had to be right when it was made, and the cylinders bolted together. He was shocked when I told him I knew of lots of machinery that had to be right, but was not, and that if I was doing the tram act, I should start from a point between the two cylinders. He told me that I should be starting from a rough casting to begin with, etc. But I was started. So I borrowed his overshirt, and went under the engine, and prospected around on the back of the cylinder saddles, and soon discovered a drilled center mark, put there by the builder, and dug the scale and dirt out of it, introduced the foreman to it, and then asked for his tram, but did not like the thing—it was too short. If he was shocked at my foolish notions before, he was paralyzed when I informed him I did not care a tinker's dam for the front driver, but was after the back one, and hunted up a piece of inch pipe for a tram stick. I put an elbow on this, and added a three-foot piece to the elbow, and another elbow to this, and sharpened a piece of wood and drove into this elbow. This was not for actual business in tramming, but to show the man the idea. He is one of those chaps who could not see the point on paper if it was in red ink. Then I placed the wooden tram in the newly discovered hole, and the short piece reached through the front driver, and let the long piece of inch pipe run back, past the centers of the driving boxes. Then I told him to have a movable-center pin and set-screw fixed on this rod, and a good iron one put in, in place of the wooden plug, and then carefully tram as far back as he could; and then with his regular tram get the front axles square with the back one. "It's a new notion," says he, "and I can't see it." I told him it was old, and used by builders generally. Then I drew him a little sketch, like that shown.



TRAMMING LOCOMOTIVES.

I explained that most any one could measure the distance from the center of one cylinder to the other, and divide it and make a prick-punch mark there. If the casting was rough, etc., it did not matter, as one side got just as far ahead, or back, as the other; and if the punch mark was not exactly in the center, the further back he got with the other end of his tram, the less the error was, as in the sketch we place the punch mark far from center. To illustrate this, see, by the partial circles drawn through the front boxes and the back ones, the difference in errors; by using a pair of dividers from the prick-punch mark, you can see the way a long tram would help correct any small error. He finally saw the point; and as I started home with my hands dirty, I wondered if there was in all the land another real foreman who was as ignorant on this little subject as this one; and I concluded to tell the tale here, not so particularly for other foremen's benefit as, perhaps, for young firemen and a few engineers who have not let their thoughts get further down than the throttle and the reverse lever.

The parting remarks of this man furnished me food for reflection for some time, and show what many men think of the cares of an engineer on duty. They were: "Well, so long, John. Come over again when you can. You engineers have some curious notions. But you ought to have. You just sit up there all day and study up examples to give us poor fellows, who are too busy to think of 'em."



PLUG COCK.

Steel Forgings.

The magnificent steel forgings and ingots exhibited at the Manchester Exhibition by Sir Joseph Whitworth & Co., of Openshaw, Manchester, excite the greatest admiration and interest of all connected with steel manufacture; they are by far the finest and most massive examples of steel work in the exhibition. The hollow-forged steel propeller shaft is perhaps the most striking and interesting piece of work; its length is 55 feet, diameter $18\frac{1}{4}$ inches, with a 10 inch hole; the coupling flange at one end is 34 inches in diameter, its weight is about 20 tons. This, however, is not the heaviest of their exhibits, although it is the longest and probably the most difficult to manufacture. The *A* tube for a 68-ton gun is the heaviest forging exhibited; its length is 39 feet 6 inches, diameter 28 inches, with a 14-inch hole, weighing about 26 tons. The complete set of hoops and tubes for the same gun are also shown, their total weight being 102 tons. All of the above are in the rough state just as they come from the forge, but they could not be much smoother or better finished if they had just come from a rolling mill. Formerly the greatest drawback to using large forgings of either iron or steel has been their extreme liability to internal flaws on account of the almost insuperable difficulty of thoroughly working such great masses of metal internally by the ordinary means of steam hammers, which give sharp, sudden blows and produce a surface effect only, without penetrating to the center of the mass. The outcome of this rather crude treatment is that the material gets thoroughly worked or rather battered about on the outside, while the core remains in its originally raw condition. Hammered steel forgings made in this way have been known to spontaneously crack in all directions within a few days of their being forged. These difficulties, however, have been successfully overcome by an improved method of forging which originated with this firm, so that their productions now enjoy a world-wide fame for perfect soundness and homogeneity. The method adopted to attain this object is briefly this. The Siemens-Martin steel ingots are compressed while in the fluid state by the well-known Whitworth process, some being cast hollow and some solid; the latter are bored out afterwards to a size, rather below that required for the finished forging. The ingot having been reheated is passed on to the forge, where it is placed on a steel mandrel fitting loosely into the hole. The ingot supported by the mandrel is now brought under the influence of a powerful hydraulic press and squeezed. The effect produced by this pressure is altogether different from that of a hammer. The heated ingot resists the blow of a hammer, but the squeezing action of the press induces a flow of the metal and forces the particles into closer contact. The pressure being released, the forging is shifted round slightly, in order to bring a fresh surface under pressure; this operation is continued all the way round. The hole is of course very considerably enlarged by this process, and requires a larger mandrel at the next heat; the ring is again pressed as before until the desired dimensions have been obtained. It is extremely interesting to watch the process of forging one of these massive rings, weighing 20 tons or more, silently and quickly with a single blow. Longitudinal sections of these ingots show that they are perfectly sound throughout.

A compressed ingot weighing 16 tons is shown at the Exhibition with the skin on just as it came from the ingot mould; parts of it are just trued up and polished to show its perfect soundness both in the center and on the outside, even within $\frac{1}{16}$ inch of the skin surface. Hollow forged propeller shafts made in this way are not only stronger than solid shafts of equal weight on account of the better distribution of the metal, but also on account of their being more thoroughly forged. One of the most important exhibits of this firm is an entirely new departure in the manufacture of boilers, viz., a weldless steel boiler shell 12 feet in diameter, 5 feet 6 inches long, and about $\frac{3}{4}$ inch in thickness. Shells thus made are forged first in the hydraulic press as described above, and then finished in a rolling mill. As far as we are aware, nothing of the kind, on anything like so large a scale, has ever been attempted before. The immense advantages arising from such a system are at once obvious; the shells can be made very much stronger and lighter than when riveted joints are used, the grain of the metal runs in a circumferential direction. We are assured that these rings can be supplied at a cost which will compare favorably with riveted shells, hence we are led to think that they will very soon be largely adopted, especially for marine boilers; their introduction will certainly mark an important epoch in the manufacture and improvement of boilers for carrying high pressures. A 14-inch air vessel shown by this firm is a beautifully finished piece of work; it is used for carrying the compressed air for the propulsion of the Whitehead torpedo such as is used by the English Government. These vessels are tested to a pressure of 1,500 pounds per square inch, their thickness varies from .25 inch to .33 inch, and their length is 5 feet 6 inches. The ring and plug are shown which were used by Sir Joseph Whitworth in his most important and useful experiments on the effective power of shrinkage. The ring of mild fluid compressed steel was heated and shrunk on to an 18-inch plug of the same material. When cold the plunger was forced out by a hydraulic pressure of 3,200 tons. The deep furrows and grooves on the surfaces of each show how thoroughly the two parts were united, and the enormous magnitude of the power of shrinkage.

Engineering.

AMERICAN MACHINIST

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☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

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NEW YORK, SEPTEMBER 24, 1887.

CONTENTS.

	PAGE
New Press and Milling Machine	1
English Boiler Inspection. By W. H. Booth	1
Recording Pressure Gauges	1, 2
Practical Drawing. By J. G. A. Meyer. Thirty-third Paper	2, 3
Fair of the American Institute	3
President Foster's Address before the Convention of the N. A. S. E.	3
Springs and Equalizers	3
The Application of Hydraulics to Cranes in Foundries, Machine, Blacksmith and Boiler Shops. By W. H. Hoffman	4
Engineering Department of Vanderbilt University	4
To Give Great Hardness and Ductility to Red Brass	4, 5
Ethics in a Machine Shop. By Jarno	5
Both Sides. By Robert E. Masters	5, 6
Fire at the Grant Locomotive Works	6
Letters from Practical Men—The Spring Roller Problem Again. By J. Begtrup—Square Driving Centers: Tool for Small Lathe. By Machinist—Improving Plug Cocks. By Engineer	6, 7
Tramming Locomotives. By John A. Hill	7
National Association of Stationary Engineers	8
Wood Engraving from Photographs	8
Demand for Skilled Mechanics	8
Suppose!	8
Literary Notes	8
Questions and Answers	9
Manufactures	9
Machinists' Supplies and Iron	10

National Association of Stationary Engineers.

The National Association of Stationary Engineers, which, through its delegates and officers, met in its fifth annual convention at Cincinnati last week, has fully demonstrated not only its right to existence, but to all the encouragement that can be accorded it. Its membership consists mainly of men holding important positions in relation to industrial affairs in the country, and when men from not over-large salaries, and from less leisure than most workers, are willing to devote both money and time to the purpose of increasing their knowledge of the work they are doing—for purely educational purposes—it may be assumed without fear of mistake that they are both honest and earnest in their efforts. Even the most selfish motives dictate that such men should be encouraged in what they are trying to do. In fact the association is not complete, not what it was intended to be, without the hearty co-operation of employers with employed for their mutual benefit. Where this co-operation exists, as it does in the subordinate associations in some cities, meeting rooms are found fitted up with means of instruction, including implements and libraries, and lectures upon matters of steam engineering bring overcrowded rooms. Members vie with each other in doing something that shall benefit the whole, and those who pay the coal bills soon come to be, if possible, the most interested workers. This is as it should be. Economy in manufacture begins with the motive power, and the character of the motive power influences every department of the works where power is used. When things go wrong in the engine room the wrong may be multiplied by twenty departments of the great works.

President Foster, from whose annual address we make an extract elsewhere, estimates that there are in the United States 100,000 stationary engineers. They wield an important influence on the cost of manufacture and ought to be strengthened by all the knowledge of engine and boiler management they can acquire.

The National Association of Stationary Engineers is engaged in an undertaking in every way commendable. It has in its membership a large number of earnest men; it deserves success.

Wood Engravings from Photographs.

A great many wood engravings of machines are made by engravers for parties at a distance, from photographs alone. To work satisfactorily from these the engraver should have a good general knowledge of machinery. The photograph gives a distorted view, and in some cases this distortion is so great that it must be corrected to some extent by the engraver. Generally, there are dark spots—recesses in the machine—where even the use of a strong glass fails to reveal defined outlines of parts. In such cases a knowledge of machinery will often help the engraver in determining what the outlines should be. Lack of such knowledge often results in the premeditated blurring of some parts that could otherwise be shown with good effect.

If a rough sketch of the machine accompanies the photograph, it will be of great assistance to the engraver. From this he can get an idea of parts not brought out in the photograph, or sketches of these indistinct parts will serve the purpose, though a complete sketch is better.

When the machine is near at hand, the engraver always prefers to see and sketch it. If he is furnished with a good photograph, the sketch may be incomplete; if he has no photograph, of course he must make a complete drawing. Another advantage in having the engraver see the machine is that by a little unnoticeable exaggeration he may be able to show some important parts that are hidden in the photograph, and thus materially increase the effect.

Sometimes a photograph on the wood block is made direct from the photograph furnished the engraver, then touched up and cut. This is not often done, however, in the instance of machines, as it is almost always possible to make a drawing on the block that is better than the photograph. Extra prominence can be given to important parts, and defects corrected in making the drawing.

Demand for Skilled Mechanics.

A well-known mechanical superintendent of an important manufacturing works recently remarked that few people were aware of the scarcity of really skilled mechanics; there was, he said, a demand for them that was far from being supplied.

We hear substantially the same remark every week. It is easy enough to find men with a little smattering of knowledge of a trade who are ready to go to work as machinists, pattern makers, moulders or boiler makers, as the case may be, but these are not the kind of men that are needed. While there are, as is frequently stated, probably a good many unemployed men, they are certainly not men who learned their trades in this country, and by a few years' practice and an endeavor to know something more about their business than the mere drudgery of it, have earned the right to be called skilled mechanics. Such men, as this superintendent remarked, are in demand, and always likely to be, just as much as the services of the best doctors or lawyers are always in demand.

There are a good many highly skilled mechanics in the country, but the proportion of those who are working at the trades without any skill to speak of is far too great. There are to-day, speaking of the trades requiring the highest skill, better reasons than ever before why boys should learn them as trades, and not work along through their lives at some little detail of them. And there are better reasons than ever before why manufacturers should give the boys a chance to learn trades.

Suppose!

Suppose a manufacturer looking around for a location, and having no particular bias, drops into a town?

Suppose he picks up and looks over the local paper, as would be the most natural thing in the world for him to do?

Suppose he finds in it page after page of trash and gossip, and stale clippings on stale subjects, but never a word of real information about the manufacturing and industrial interests of the town, or anything in particular to indicate that the town has any manufacturing or industrial interests worth speaking of?

Suppose he decides to look up a townier kind of a town? What then?

Suppose a list is made of the papers doing just this sort of thing; can the backward condition of manufacturing in their respective towns be taken as evidence that the towns are slow, because their local papers are slow; or that the local papers are slow, because the towns are slow?

We believe that when railroad corporations act contrary to the best interests of the people they should be brought to terms without delay. By the same reasoning, when citizens try to crowd railroads into doing unreasonable things they should suffer the consequences of their unreasonableness. The Pennsylvania Railroad runs through Jersey City on a level with the streets, and the streets which the road crosses within the city limits are the principal ones. Many people are killed every year at these crossings, notwithstanding the railroad corporation takes reasonable precaution against accident. Years ago the railroad company proposed to elevate its tracks through Jersey City, but it was met by insurmountable objections on the part of the city authorities and the citizens. The project was unwillingly abandoned by the railroad. Again, and largely because the citizens and the press of the city demand it, the railroad proposes, at a cost extending into millions of dollars probably, to raise its tracks. But again it is met with objections and bills of damages that appear to be entirely unreasonable. The railroad now proposes to move its terminal station in Jersey City, and with it, of course, the passenger ferry station, to where it has right of way. To do this will decrease valuation in some parts of Jersey City enormously. But the company is manifestly in the right, and unless the citizens recede from their untenable position they ought to suffer the consequences. The railroad seems to be willing to do everything that is right in the matter, and there is no reason why it should be victimized.

While we hear a great deal—and it is true—of remarkable development of the South and West, we are likely to forget that the East is—rather more quietly, it is true—making progress. New towns and cities are not springing up in a night-time or two, but there is constant increase in manufacture and general business. Some people have been so rash in times past as to express the belief that the height, for years to come at least, of manufacture in New England had been reached. But there is good evidence to the contrary. According to *Bradstreet's*, 200—probably more—new manufacturing enterprises, or new factories, have been started in New England since the first of January. There is no way of coming at the capital invested in these enterprises, but many of them are of large magnitude. They afford all the evidence needed that manufacture in New England is growing at a very healthy rate.

Since we advocated increasing the cost of taking human life through corporate or individual carelessness from $5,000 to $50,000 we have read several arguments against the proposed change. Not one of these arguments takes note of the fact that $50,000 is too cheap for taking a human life through gross carelessness, or that if there is no carelessness there will be no ground for damages. The change proposed was not to the end that more damages, in the aggregate, should be paid for killing people, but that fewer people should be needlessly killed. We have seen no fair reason given why the proposed change should not be made.

If every boy in the country who has his way to make would sit down with the fact, long enough to master it, that nothing but hard honest work will bring anything worth having in this world, there would be fewer young men looking for some kind of work where they could keep their hands clean, and in doing which they could lie in bed till eight o'clock in the morning. There would be fewer looking for such jobs, and more who were anxious to work at trades, where the prospect of amounting to something is much greater.

Some of our daily contemporaries are congratulating themselves on the assumption that, in the event of war, there is nothing to fear from hostile fleets, because they must do their firing at a distance, and firing from a ship at a distance is very uncertain in point of accuracy. The argument is not good. They forget that New York is a big mark to shoot at. Better realize the fact that the city is practically defenseless, and remedy the deficiency without delay.

Literary Notes.

We have received from Angus Sinclair, secretary of the American Railway Master Mechanics' Association, the printed report of the proceedings of the twentieth annual convention of that association. It makes a book of more than 200 pages, well edited and printed. It is full of practical matter of interest to railroad men and mechanics, cuts being used where necessary.

The *American Builder* is the name of a paper that tells its readers how to build houses. We notice that it builds editorials out of stolen material. If it instructs its

readers to get material in the same way for building houses it may lead them into trouble. The *American Builder* appears to be something more than three years old, and cannot too soon take up the study of the ethics of honesty.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(381) J. C., Waterbury, Conn., writes: Please name the mixtures for emery pencils which will not glaze. *A.*—These mixtures are trade secrets which we cannot obtain.

(382) S. J., Quakertown, N. J., writes: I wish to put up a shaft to transmit five horse-power; it will be eight feet long, and will run about 600 revolutions per minute; the engine belt will be at one end of the shaft, and the machine belt at the other end. What should be the diameter of the shaft? *A.*—The diameter of a wrought-iron suaft for this purpose should be one inch.

(383) T. H., Watertown, New York, writes: Will you please inform me of any device manufactured or in use by which, when cutting a screw in a lathe, and without stopping the lathe, the nut may be disengaged from the leader, the carriage moved back by hand, and the nut engaged again with a certainty of the tool always starting right? *A.*—See AMERICAN MACHINIST of April 4, 1885.

(384) F. E. S., New York, asks: Can hot water be pumped into a boiler carrying 60 pounds steam pressure? The water is taken from a 1-inch coil heater; the pump used is a horizontal plunger pump; check valve is straight. *A.*—The pump will force hot water into the boiler, providing the heater is placed somewhat above the pump, so that the water can flow to the pump. If the heater is placed below the pump, you will experience great trouble in the suction, because pumps cannot lift water having a high temperature.

(385) E. C., Camden, Ark., writes: In putting a pump in a well about 50 feet deep, the pipe came cut to the proper length; the cylinder was about 15 feet from the bottom. There was a foot valve provided with a strainer. A man who works with pumps a good deal claims that if the foot valve had been left off the pump would work easier. Is he correct? *A.*—The use of a foot valve should not make any difference in the working of the pump if the latter is of the ordinary design; and the fact of having a foot valve sent with the pump would indicate that makers of the pump believe it to be advisable to have the foot valve attached.

(386) A. H. H., Mt. Sterling, Ill., asks: 1. Where and in what position is the spark arrester placed in the extension-front boiler of a locomotive? *A.*—The spark arrester or netting is generally placed directly over the upper row of flues; it extends horizontally for some distance in the extension front, and then slopes upwards to the top of shell. 2. What is meant by the wheel base of a locomotive? *A.*—In a locomotive we have the "rigid wheel base" and the "total wheel base." By the rigid wheel base of any locomotive is meant the distance from the center of the rear to the center of the front driving wheel. By total wheel base of any locomotive is meant the whole distance from the center of the rear driving wheel to the center of the front truck wheel. See illustrations in AMERICAN MACHINIST of July 4th, 1885.

(387) H. A. H., Worcester, Mass., writes: I am a tool dresser, and in our place we have a great many shafts to weld collars on. I have never been able to find a rule in any work that I have seen which will give the proper length to cut a piece of iron to wrap around a shaft to form the collar. Would you give me a rule by which I could find the length of the iron used to form the collar? For instance, what should be the length of a piece of iron ½ of an inch square to wrap around a 2-inch shaft? Also the length of a piece of iron 1 inch square to form a collar for the same shaft. *A.*—The length of the piece of iron is found in the following manner: Add to the diameter of the shaft the thickness of the collar; then find the circumference of a circle whose diameter is equal to this sum of diameter of shaft and thickness of the collar; to the circumference so found add a sufficient amount for welding; the sum will be the length of iron required. Applying this rule to your example, we have for the length of the half-inch square iron around the 2-inch shaft $(2+\frac{1}{2}) \times 3.1416 = 7.854$ inches, say 7⅞ inches, which is the length required to wrap around the shaft; to this must be added the necessary amount for welding. For the 1-inch square iron around a 2-inch shaft, we have $(2+1) \times 3.1416 = 9.4248$ inches; add to this length the necessary amount required for welding; then the length of 1 inch square iron will have been obtained. The circumference of a circle is always found by multiplying the diameter by the constant number 3.1416.

(388) H. B. S., Glenwood, Mass., writes: 1. Can you inform me of any cement or process which will render a board of alternate layers of cement and paper waterproof—the nearest approximation to water-proof glue, suitable for the purpose of forming a water-proof board ¼ of an inch thick by glueing layers of paper on a form? *A.*—The nearest approximation to water-proof glue that we know of is the following: Take of gum shellac three parts, caoutchouc (india rubber) one part by weight. Dissolve the caoutchouc and shellac in separate vessels in ether free from alcohol, applying a gentle heat. When thoroughly dissolved mix the two solutions, and keep in a bottle tightly stoppered. This glue resists the action of the water, both hot and cold, and most of the acids and alkalies. If the glue be thinned by the admixture of ether, and applied as a varnish to leather, along the seams where it is glued together, it renders the joint or seam water-tight and almost impossible to separate. We believe this glue will answer your purpose, but would advise you first to give it a trial before making preparations for extensive use. 2. Any good way for rendering such a board dense, tough and smooth, when it is inconvenient to apply pressure in drying on a form? Also a method of overcoming the difficulty of the board, made as above, tearing through the center of some one of the sheets of paper? *A.*—We cannot recommend any other method for the foregoing purpose than that which experience will teach you in making these boards. 3. Is shellac affected by prolonged soaking? *A.*—If shellac is left to soak in water for a prolonged period, we believe it will be affected.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Brass Gears. See Adv., page 16.

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Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

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Upright Drills from 20" to 36" inclusive. Currier & Snyder, Worcester, Mass.

For Improved Cooper Stoves, send to Variety Machine Co., Warsaw N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., Y. N.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Injectors, Ejectors, Oil Cups, Sight Feed Lubricators, etc. Arthur Appleton, 45 Cortlandt st., N.Y.

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The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Having opened a mechanics' tool and machinery supply store at Cleveland, O., we solicit inquiries and quotations. C. H. Presley & Co.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Sept. 10, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Reed's Engineer's Hand-Book to the Local Board Examinations. Eleventh edition revised and enlarged, with 260 diagrams and 36 large plates. 8vo., cloth, $4.50, post-paid. Catalogue of books free. E. & F. N. Spon, 35 Murray st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

MANUFACTURES.

David City, Neb., has voted to expend $22,000 for water-works.

Noble Brothers will enlarge their car works at Anniston, Ala.

The Anniston Machine Company will build shops at Anniston, Ala.

Richard Church will enlarge his machine shop at Birmingham, Ala.

The citizens of Lapeer, Mich., are to vote on the question of water-works.

The Louisville and Nashville Railroad will enlarge their shops at Birmingham, Ala.

Pontiac, Mich., has voted in favor of a $75,000 appropriation for water-works purposes.

The saw and planing mill of L. T. Willis at Crescent City, recently burned, will be rebuilt at once.

The machine shop and foundry of Miller & Bokenkamp, at Fort Madison, Iowa, will be rebuilt at once.

The Du Quoin Iron Works, Du Quoin, Ill., are perfecting a machine for making a barrel with only one stave.

The Duluth Railroad shops will be located at Gladstone, Minn. They will furnish employment to 250 men.

Timothy Deuane and John Porteous, of the St. Paul Iron and Brass Works, St. Paul, Minn., will erect another building, 40x300 feet.

The city of Owosso, Mich., has voted to bond itself $25,000 to secure car shops by the Toledo, Ann Arbor and North Michigan Railroad.

The *Weekly Courant*, of Columbia, Pa., says there is talk of forming another iron company in that town, but omits to say who is doing the talking.

Greenleaf & Co., lumber dealers, who have a yard at North St. Paul, Minn., will put in machinery for a wood-manufacturing business next season.

The *Journal of Commerce*, of Denver, Col., says "the question of a paper mill is again receiving attention." It forgets to say by whom it is being considered.

Everett Clark, of Boston, has bought the Goulding mill property at Malden, Mass., at assignee's sale. The mill will be refitted and work begun at an early date.

P. F. Burke, at his machine shop on Dorchester avenue, Boston, is putting in a new thirty horse-power boiler and engine and making other improvements, and will start up early the coming week.

Among the shipments recently made by the Page Belting Company, of Concord, N. H., is belting and lace leather for the new works of the Northern Pacific Terminal Company, Portland, Oregon.

The North American Asphaltum Company is putting up works at St. Louis, Mo. The company will mine the asphaltum, and put in condition for the market at these works, which will cost to erect about $100,000.

W. E. Hawley, F. A. Camp and others are interested in the organization of a condensed milk company at Hawleyville, Conn. The Housatonic Railroad Company is to be asked to put up the necessary buildings.

The W. G. & A. R. Morrison Machine Company, of Willimantic, Conn., have made surveys for their new contemplated brick manufactory. The new building will be 150 feet long by 50 feet wide, and four stories high.

The Glen's Falls (N. Y.) Board of Trade have agreed on measures for the formation at once of a stock company to erect a large building furnished with ample steam power for rental to small manufacturers. It is a good way to build up a town.

The proprietors of the Decatur (Mich.) Roller Mills have been experimenting with crude oil for fuel in place of coal. The results have been so satisfactory that they will replace their old boiler with a new one especially adapted to the burning of oil.

The Horton Manufacturing Company, Ft. Wayne, Ind., are erecting an addition to their works, 35x100 feet, and two stories high. This increase in capacity has been necessitated by the large increase in orders. The company recently shipped 120 washing machines to Australia.

The Hix Automatic Car Coupler Company has been organized in Rockland, Me., as follows: President, Samuel Bryant; secretary, D. N. Mortland; treasurer, George W. Berry; directors, Samuel Bryant, J. S. Willoughby, Capt. Henry Pearson, D. N. Mortland and O. P. Hix. Capital stock has been fixed at $500,000.

The St. Paul Park Silk Company, St. Paul, Minn., has been incorporated, with $50,000 capital. Its officers are D. D. Thorpe, president; Geo. E. Ovenshire, general manager and treasurer; and Geo. Hall, superintendent. The concern will occupy one floor, 50x100 feet, in the factory of the St. Paul Knitting Works, employing twenty hands.

Information has been received in Philadelphia of a large steel and iron industry which is to be started in Lebanon, Pa. Mrs. G. Dawson Coleman, widow of the deceased millionaire of that name, has purchased a large tract of land in that place upon which it is stated she will erect large iron and steel works. The cost of the land was nearly $40,000.

The *News-Herald* says: "There is no opportunity anywhere to make a safer investment of capital than in a furniture manufactory in Jacksonville, Fla., though, strange to say, there is not one in the city. With $50,000 capital a furniture manufacturer could establish a business in this city that would yield the handsomest dividends from the beginning."

The new factory that the Elyria Shear Company is building at Fremont, Ohio, consists of a main building, 36x130 feet, with an L 30x60 feet, all two stories, and an engine and boiler house, 30x38 feet. They will fit the works up with the best and latest improved machinery, and when completed it will, it is claimed, be the best-arranged and largest shear works in the United States.

The Wisconsin Central Railroad shops alone will bring enough population to North St. Paul to constitute a small town. It is said that they will duplicate the shops at Waukesha, Wis., and will employ 1,600 men; and as most of these men will be the heads of families, a heavy influx of people is looked for when the shops get into operation. The shops are to be completed in six months.

The St. Paul and Minneapolis Rapid Transit Company has been incorporated to construct either an elevated or surface railway from St. Paul to Minneapolis, Minn. The principal place of business will be St. Paul. Capital stock, $2,000,000. Incorporators: Peter R. L. Hardenbergh, Charles W. Hackett, William Lindeke, James P. Moore, Gustav Willius, St. Paul; Charles R. Chute, Saml. C. Gale, William W. Huntington, Anthony Kelly, Minneapolis.

Frederick M. Wheeler, 93 and 95 Liberty street, New York, has republished in pamphlet form, and for free distribution, the valuable paper on "The Machinery of Small Boats, etc.," read at the twenty-eighth session of the Institution of Naval Architects, by A. Spyer. In the back of the pamphlet are cuts and description of Mr. Wheeler's surface condenser. The paper is a valuable one, as indicating much that has been done for the past ten or twelve years in building small steam vessels.

Arrangements have been made to move the manufacture of the Emerson Power Scale Company to Florence at once. D. G. Littlefield, president of the Florence Machine Company; Oscar N. Kyle the treasurer, and E. A. Thissell, of Lowell, have taken the stock of the company organized to manufacture the scales, and have just bought out the inventor, James Emerson. It will take several weeks to put in the new machinery, and twenty-five men will be employed as soon as the works are ready to start.—*Springfield* (Mass.) *Republican.*

The Dexter Machine Co., Dexter, Me., the co-operative association that has succeeded the Dustin Manufacturing Company, appear to be entering on a prosperous business career. The company is composed of some of the Dustin Company's best workmen. The greater part of their machinery they are manufacturing for themselves. They have received the patterns for small lathes, from 6 to 12 feet bed, and 16 inches swing. These lathes will be manufactured for the market, there being a large demand for lathes of this size.—*Industrial Journal.*

Work will begin at once on an addition, 60x125 feet and four stories high, to the Millville Rubber Works, which will make the extensive buildings about one-third larger. Work on the addition, which will be of brick, will be rapidly pushed. When completed, about 300 additional employes will be needed, making the whole force over 1,300. It is proposed to finish all work on this addition before December 1. This will materially add to Millville's prosperity, and gives proof also of the prosperous condition of the Woonsocket Rubber Company, of which the Millville shops are a branch.—*Worcester* (Mass.) *Spy.*

The Granite Iron Rolling Mills of the St. Louis Stamping Company will resume operations next week, immediately after the completion of extensive repairs and improvements. Heretofore the mills have used gas in their heating and annealing furnaces, but not under their boilers. Upon restarting the latter will be fired with gas, for which preparations are now making. There are six of the boilers, divided into two batteries of unequal number. The saving in fuel is expected to be quite important. The galvanizing department adjoining the mills has been provided with a new warehouse since the shut down.—*Age of Steel.*

According to the *Pioneer-Press*, forty manufacturing establishments have located in the city of St. Paul, Minn., within the past eighteen months, adding about five million dollars to the manufacturing capital of the city and over 35,000 souls to the population. Included in these are the following: The R. H. Beach Manufacturing Company, wagon manufacturers, have removed from Detroit, Mich., to North St. Paul, and will double their present capacity next year. The Cramer & Coney Manufacturing Company, box manufacturers, have just begun the erection of their factory at North St. Paul. It will be 56x100 feet, two stories high, with an addition 40x40 feet, and will employ about 50 men. The Luger Furniture Company will remove their entire factory plant from Wabasha to North St. Paul. They employ 200 to 250 men. W. A. Heath & Son will erect buildings this fall for the manufacture of wood-working machinery at North St. Paul.

T. R. Bonner, W. L. Herndon and others are interested in starting a new manufactory at Tyler, Tex.

The Ivins & Sons Machine Company recently made at their new works at Decatur, Ala., the first iron castings ever made in Morgan county. This company has recently built large works at Decatur, including machine shop, foundry, boiler shop, blacksmith and wood-working shop. The principal shops are supplied with Yale & Towne overhead cranes and needed appliances for handling work.

Machinists' Supplies and Iron.

NEW YORK, Sept. 8, 1887.

Iron—The demand for American pig is the same in character as for the past six months, viz., for small lots and immediate delivery. The better brands of No. 1 X Foundry do not appear to be quite so plenty as two weeks ago, but there is no reason to believe that prices will be materially affected. We quote standard brands, $21 to $22 for No. 1 X Foundry: No. 2 X, $19.50 to $20.50; Grey Forge, $17.25 to $18.

Scotch Pig—Scotch brands have been in fair demand. We quote Coltness, $22.50 to $23: Glengarnock, $21.25 to $21.75; Gartsherrie, $21.25 to $21.75; Summerlee, $22 25 to $22.75; Eglinton, $20.50; Langloan, $21 to $21.50; Dalmellington, $20.50 to $21.

Lead—There have been no transactions of any account. The asking price is 4.65c, with 4.60c. offered.

Antimony—Hallett's, 8¼c; Cookson's, 9c.

Copper—The market is quiet, with no speculative tendency apparent. Spot lots have been offered at 10.80c., with 10 60c. bid.

Spelter—Refined, 5¾c. to 6c.

Tin—Jobbing lots of Banca have sold at 24c.; Straits and Malacca, 23.30c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Good machinists. Adams & Richards Machine Co., New Brunswick. N. J.

A mech'l draftsman, designer and pattern maker wants position. Box 54, AM. MACHINIST.

Situation wanted by a well-posted designer and machine draftsman. Address T., AM. MACHINIST.

Mechanical draftsman wants position; has college education and several years' experience; correspond with A. D., AM. MACHINIST.

Foreman wanted for shop employing 20 men; must be a capable machinist—energetic, sober and reliable. Address Box 55, AM. MACHINIST.

Machinist and millwright of skill and experience in designing and building tools and machines for special purposes wishes situation with some manufacturing company. T. R., AM. MACHINIST.

Wanted—An energetic practical machinist, with five to ten thousand dollars cash, to take charge of an old-established factory, and make printing presses by contract. Address, with reference, age and experience, "Job Press," care AM. MACHINIST.

Machinery Salesman—Wanted, a salesman of experience, possessed of mechanical ability, with full knowledge of steam and hydraulic engineering; would be expected to travel most of the time; must be a strictly temperate man; references required. Address, stating age and particulars, Post Office Box 2237, Boston, Mass.

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Stationary boat engines, boilers, best, cheapest, 1 to 10 H. P. Washburn Engine Co., Medina, Ohio.

Wanted—Thompson indicator, with full set high-pressure springs. Address, with price and particulars, N. W. C., AM. MACHINIST.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. I. A. Weston & Co., Syracuse, N. Y.

Wanted—A complete set of Knight's Mechanical Dictionary; must be in good condition and cheap. Address W. B. Osborn Tuskaloosa, Ala.

An experienced teacher and mechanic desires engagement to teach mech'l drawing; tools, wood and iron workshop practice. "Honest Worker," AM. MACHINIST.

A. C. Christensen, 26 Church st., N. Y., mech. and hydraulic engineer, late chf. draftsman at H. R. Worthington; mechanical and patent drawings; patents of natural gas and water meters for sale.

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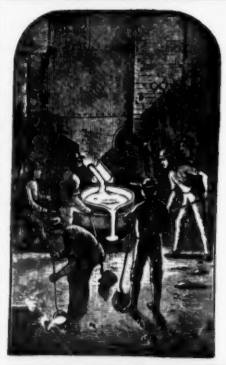

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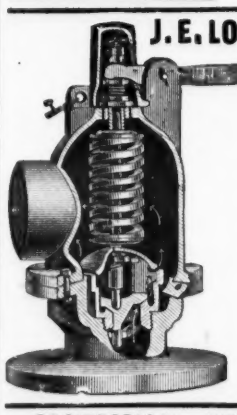

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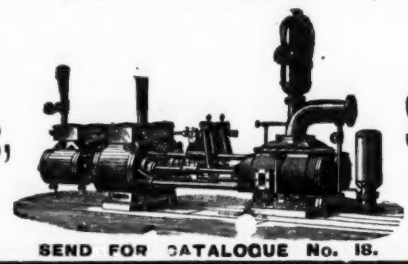

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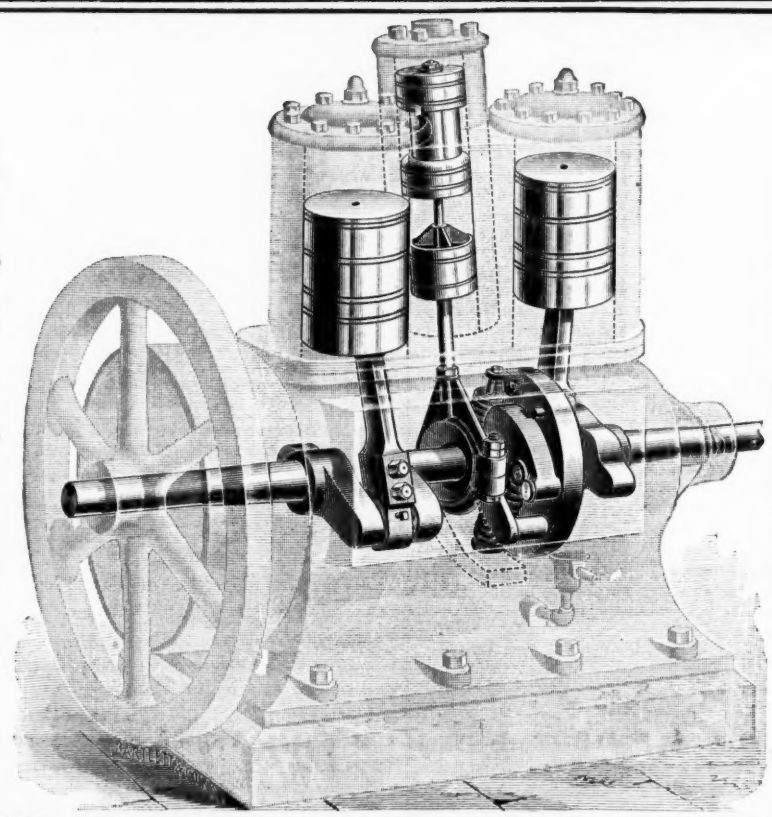

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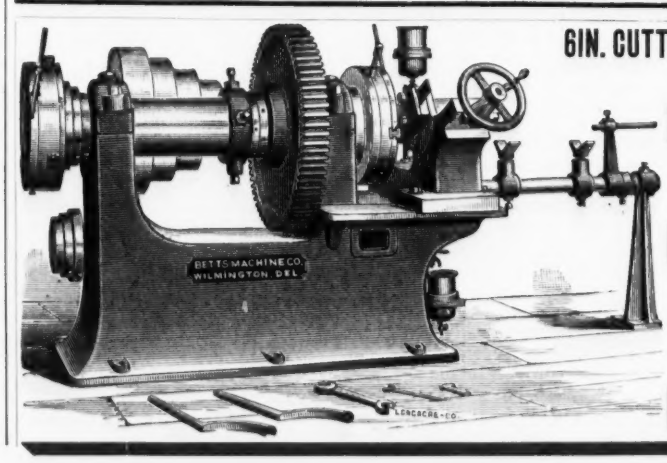

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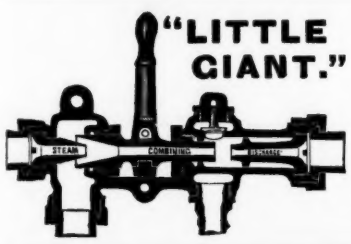

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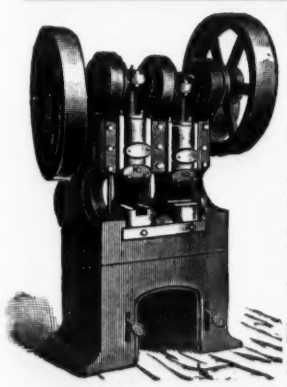

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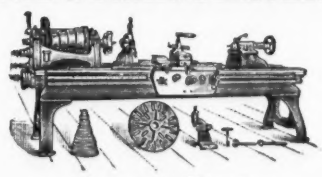

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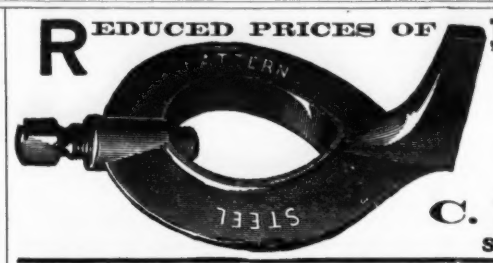

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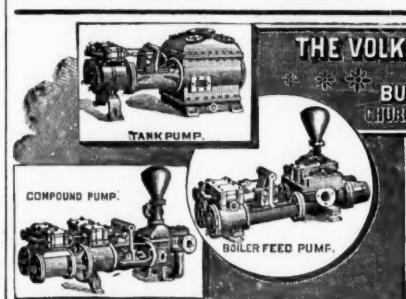

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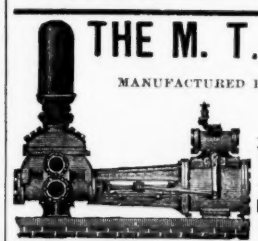

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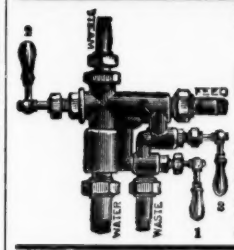

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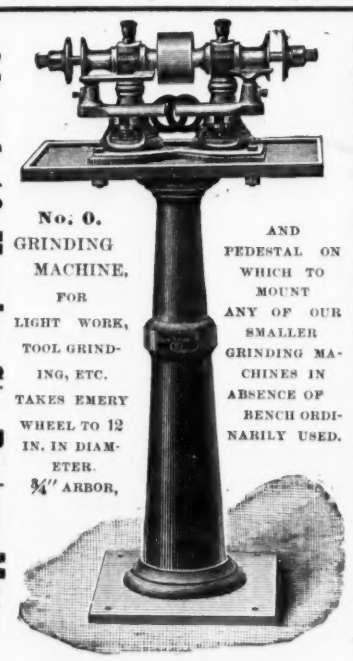

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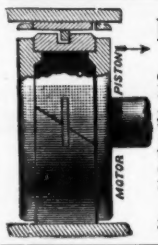

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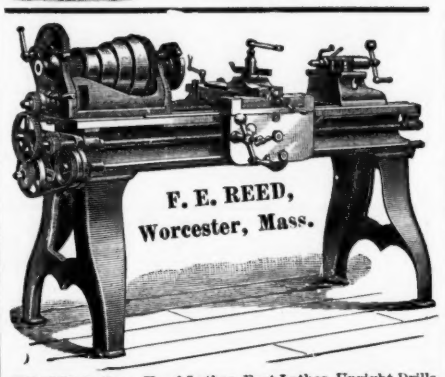

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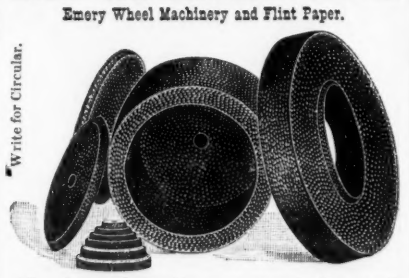
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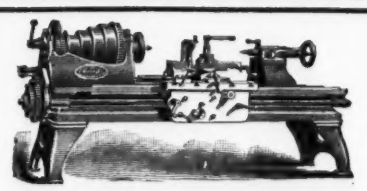
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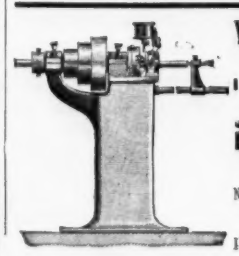
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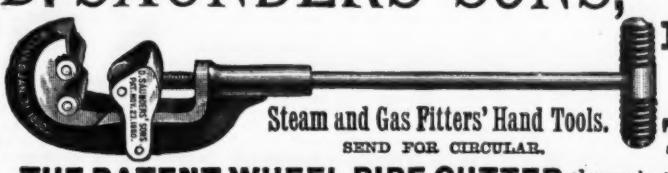
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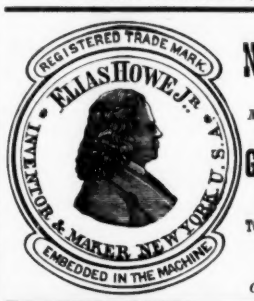

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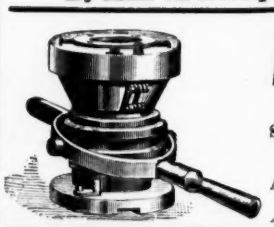
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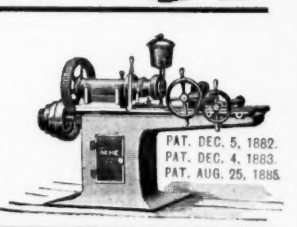

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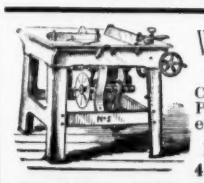
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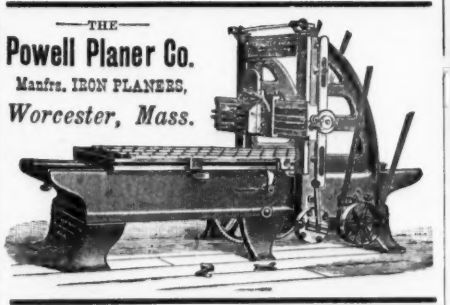

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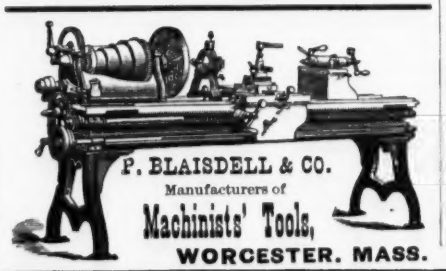
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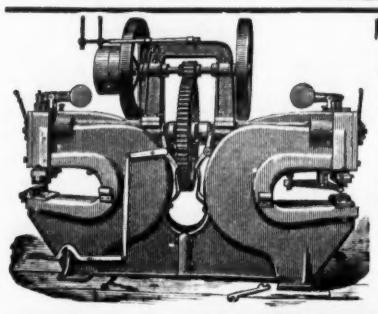

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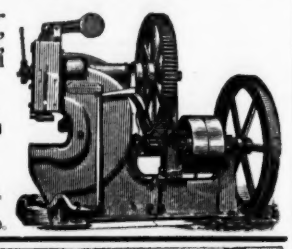

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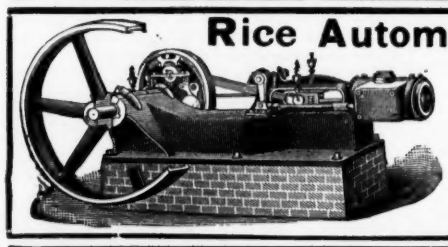

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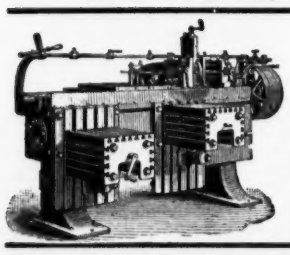

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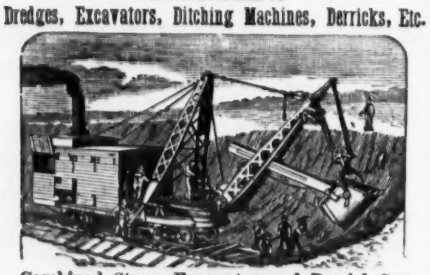

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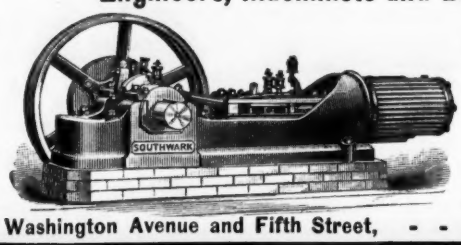

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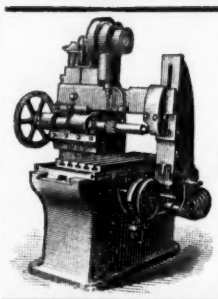

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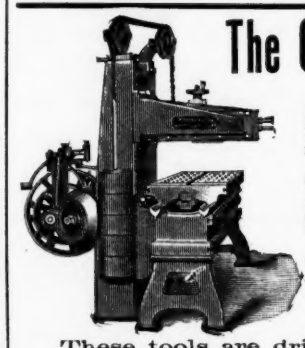

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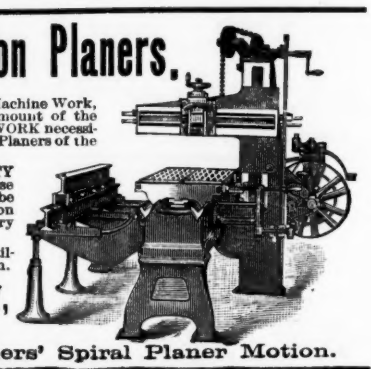

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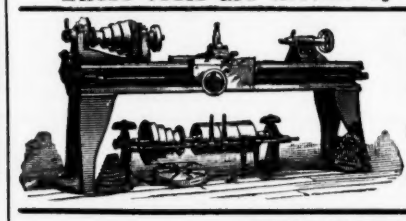

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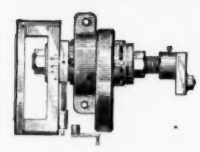

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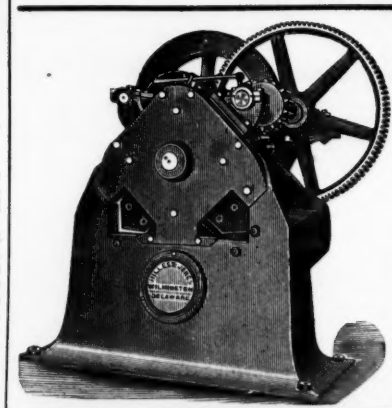

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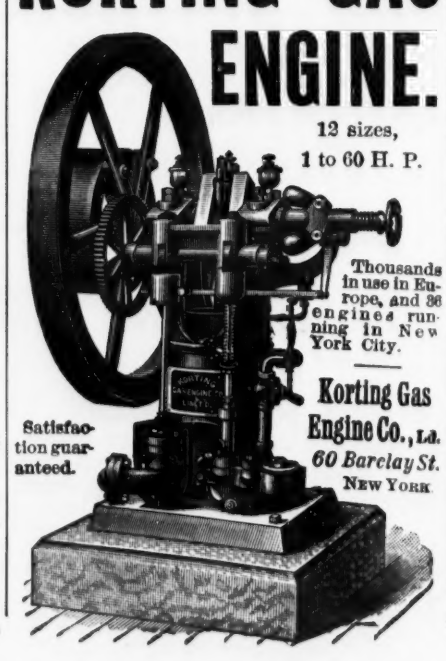

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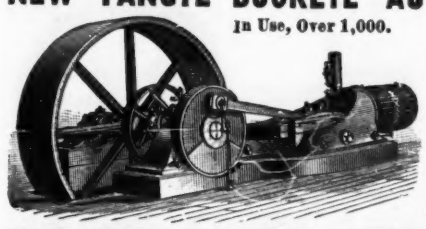

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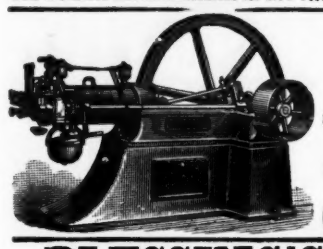

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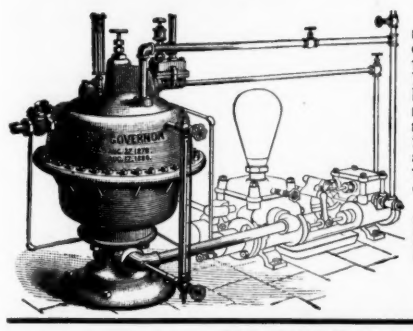

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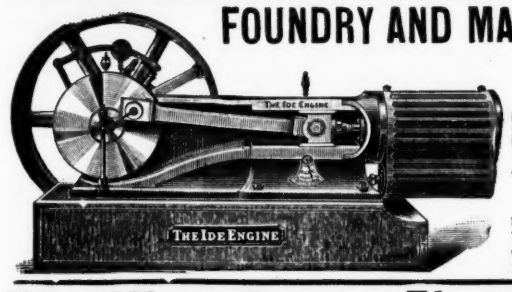

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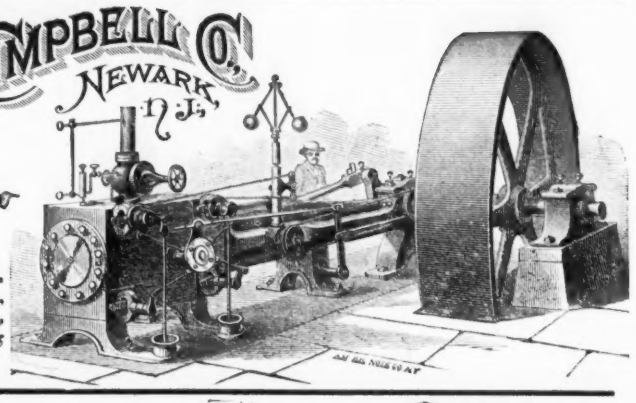

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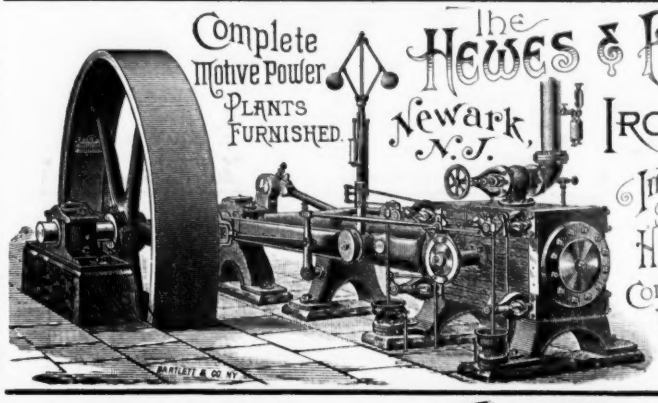

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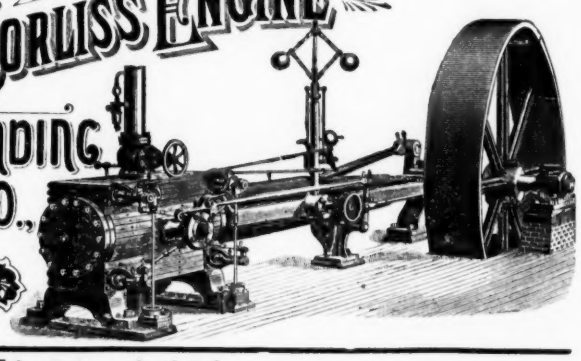

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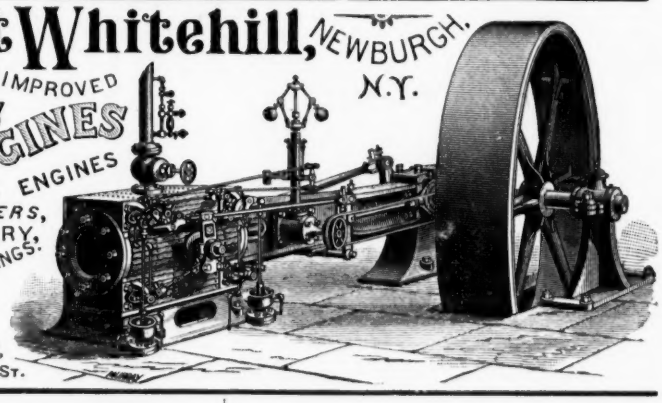

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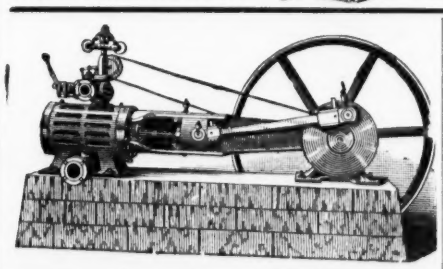

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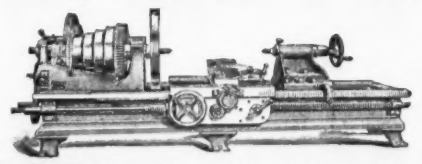
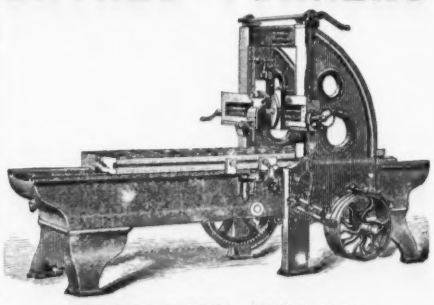


LATHES AND PLANERS



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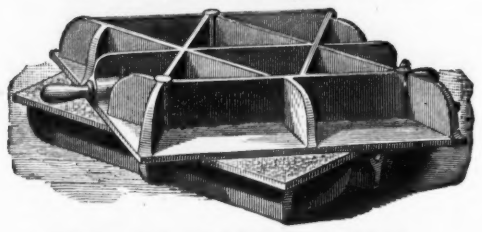

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6 in. x 12 in.	10 in. x 15 in.	14 in. x 14 in.	18 in. x 36 in.
6½ in. x 18 in.	10 in. x 30 in.	14 in. x 18 in.	24 in. x 24 in.
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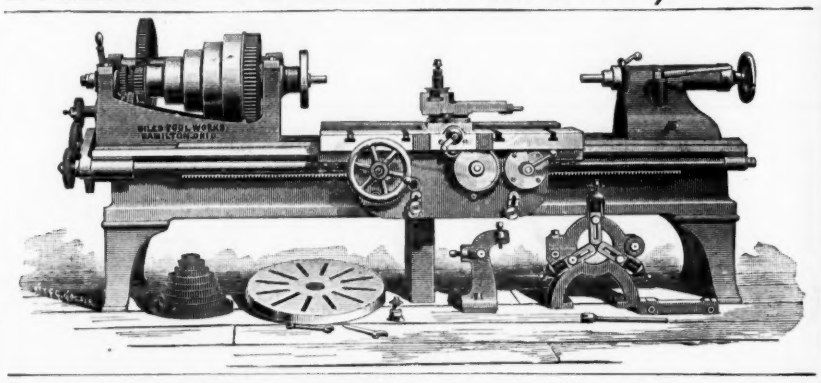

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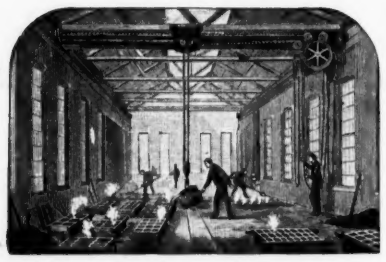

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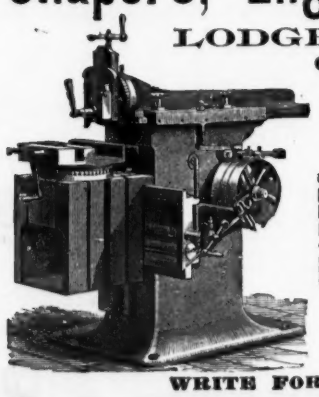

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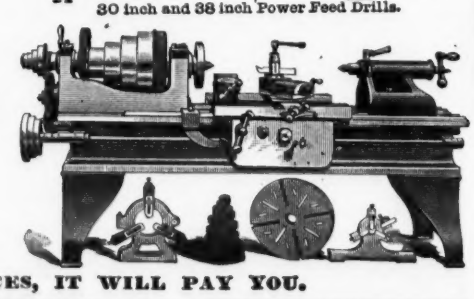

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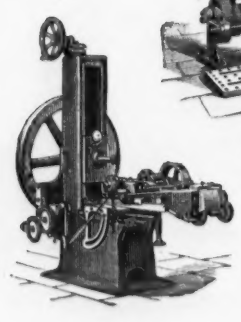

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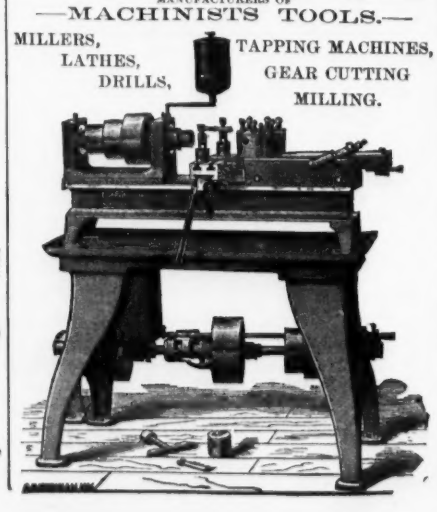

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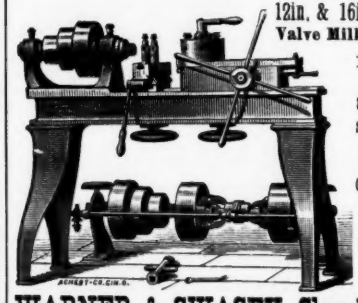

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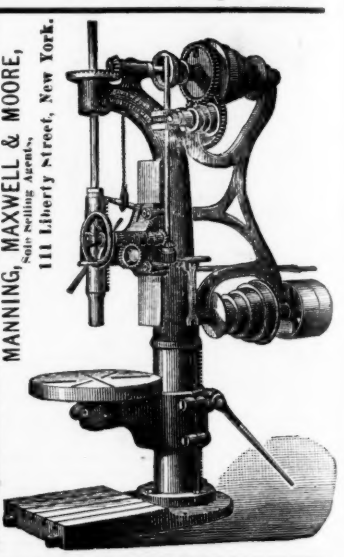

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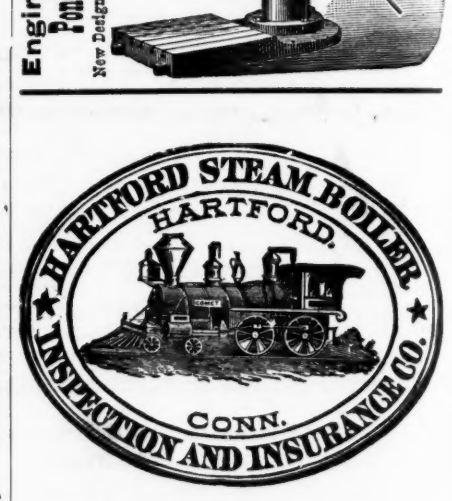

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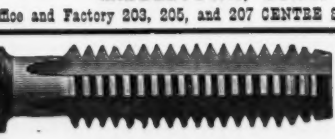

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